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Cetrarioid lichens from India revised, including *Nephromopsis awasthii* sp. nov. and new records

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Abstract—Morpho-taxonomic studies of cetrarioid lichens from India recorded 46 species representing *Cetraria, Melanelia, Nephromopsis*, and *Platismatia*. *Nephromopsis awasthii* is described as new to science; and *Cetraria endochrysea*, *C. sinensis*, *Melanelia agnata*, *Nephromopsis ciliaris*, *N. morrisonicola*, *N. pseudocomplicata*, *N. pseudoweberi*, *N. rugosa*, *N. weii*, and *N. yunnanensis* are reported for the first time from India. A key to all genera and species of cetrarioid lichens in India is provided together with their detailed morpho-taxonomic characters and distribution.

Key words—ascomycetes, diversity, Himalaya, *Parmeliaceae*, taxonomy

Introduction

Parmeliaceae, the largest lichen family in the world, comprises c. 60 genera and more than 2700 species (Thell & al. 2012, Divakar & al. 2017). As per their morphology foliose, fruticose, and transient erect subfruticose forms occur within *Parmeliaceae* while crustose forms exist only in the phylogenetically ancient subfamily *Protoparmelioideae*. Cetrarioid lichens are characterized by an erect foliose or subfruticose thallus loosely attached to the substrate

and the presence of marginal apothecia and pycnidia (Kärnefelt & al. 1998, Randlane & al. 2013).

Acharius (1803) described the first cetrarioid genus *Cetraria*, while Rassadina (1950) studied *Cetraria* and reported 76 species from different parts of the world. *Cetraria* is widely distributed in the world's temperate, alpine, Arctic, and Antarctic regions. Kärnefelt & al. (1992, 1993) revised the cetrarioid lichens, dividing them into *Cetraria* and more than ten new genera. Randlane & al. (2013) cited 149 cetrarioid lichen species representing 25 genera worldwide. Based on molecular phylogeny, Divakar & al. (2017) synonymized *Allocetraria, Cetrariella, Usnocetraria,* and *Vulpicida* with *Cetraria* and placed *Ahtiana, Arctocetraria, Cetreliopsis, Cetrariopsis, Flavocetraria, Flavocetrariella, Kaernefeltia, Masonhalea, Tuckermanella, Tuckermannopsis,* and *Tuckneraria* in synonymy with *Nephromopsis.*

Babington's (1852) descriptions of *Cetraria ambigua*, *Evernia stracheyi* [= *Cetraria laii*], and *C. stracheyi* [= *Nephromopsis stracheyi*] based on the collections of Strachey & Winterbottom from central Himalaya are the first reports of cetrarioid lichens from India. Subsequently, numerous new records from India have been reported by Awasthi (1982, 2000), Divakar & Upreti (2003, 2006), Sinha & Elix (2003), Mishra & Upreti (2015a,b), and Jagadeesh Ram & Sinha (2010).

For more than five decades, a large number of cetrarioid lichens have been described in various regional floristic accounts of India, but a consolidated account is not available. Here we attempt to provide a detailed enumeration of the cetrarioid lichens of India.

Materials & methods

The present study is based on collections of cetrarioid lichens preserved in the herbarium of the CSIR-National Botanical Research Institute, Lucknow, India (LWG), which also includes the personal herbarium of Dr. Dharani Dhar Awasthi (LWG-AWAS) and Lucknow University Herbarium (LWG-LWU). Some specimens were also borrowed from herbarium of Botanical Survey of India, Sikkim Himalayan Circle, Gangtok (BSHC). In total the study included more than 5000 specimens representing different phytogeographic regions of India. The morphological characters of the specimens were examined by using stereo zoom Leica S8APO and light DM2500 microscopes attached with a camera. All anatomical measurements were recorded in plain water, while 10% KOH was used for detailed study of asci and ascospores. For spot tests the usual reagents of K, C, and P were used and for identification of lichen substances by thin layer chromatography (TLC) was performed in solvent system A and B following Orange & al. (2001). The specimens were identified up to species level with the help of literature of Awasthi (1982, 2007),

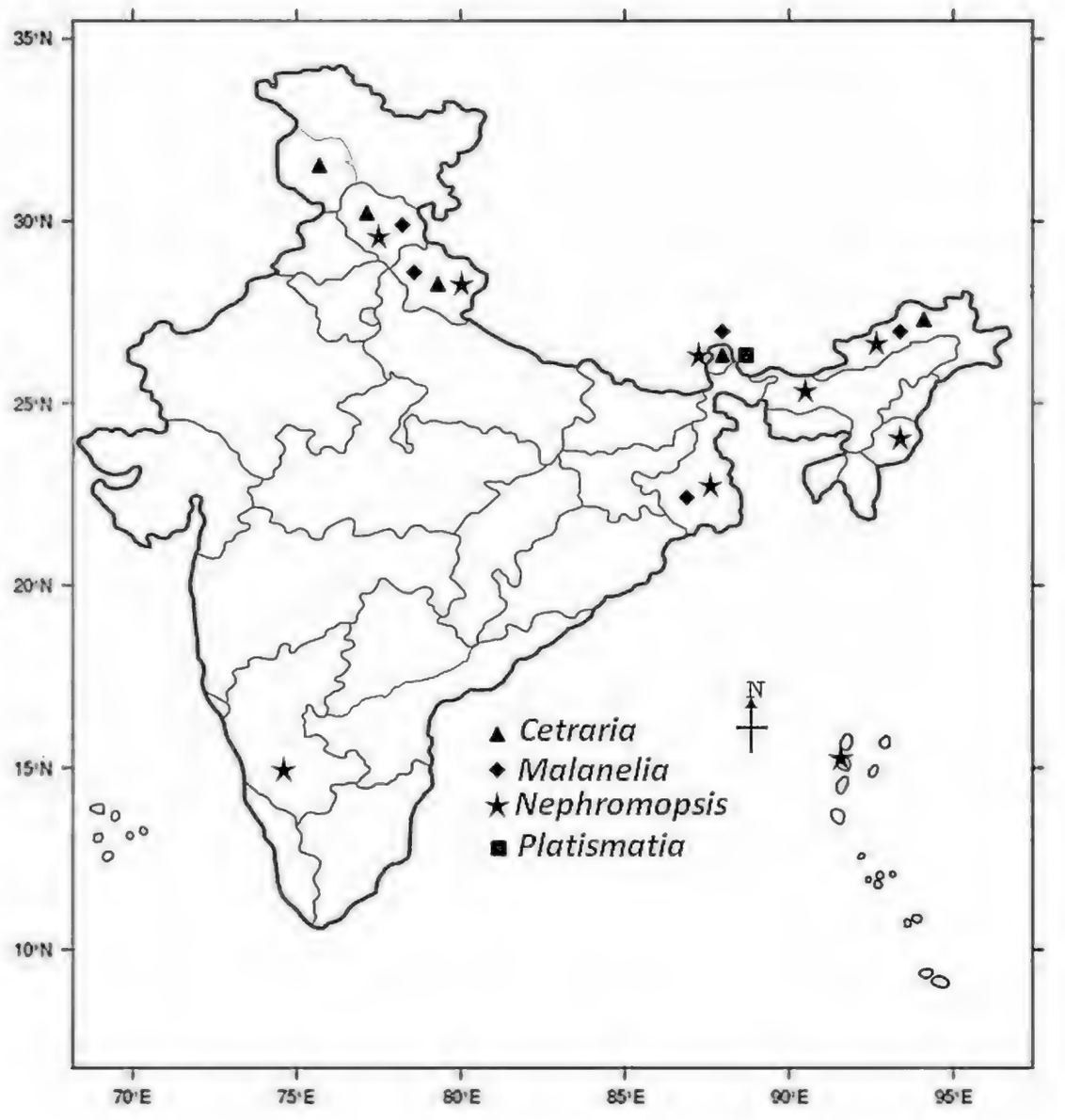

Fig. 1. Map showing the distribution of cetrarioid genera in India.

Thell (1996), Randlane & Saag (1998), Kärnefelt & al. (1993), and Kärnefelt (1979) and confirmed by matching with available type specimens at LWG herbarium.

Results & discussion

The study covers 46 species belonging to four genera of cetrarioid lichens (Fig. 1). *Nephromopsis* was represented by 27 species, *Cetraria* by 16 species, *Melanelia* by three species, and *Platismatia* by one species. Most Indian cetrarioid lichens typically grow on bark (26 species); others grow on soil (14 species) or on rock (4 species). Three species are common on bark and

soil, whereas *Nephromopsis cucullata* and *N. nivalis* occur on both soil and rock. *Cetraria islandica* and *C. muricata* grow in association with mosses; *Melanelia stygia* mostly grows over rocks in association with other lichens such as *Physciaceae* spp.; and *Nephromopsis laii*, *N. pallescens*, and *N. stracheyi* are common on deciduous trees, such as oak and conifers in India.

Within India most cetrarioid lichen species occur in the Himalayan region; 31 species occurring in Sikkim state (Eastern Himalaya), 27 in Uttarakhand (Western Himalaya), 12 in Arunachal Pradesh (Eastern Himalaya), nine each in Himachal Pradesh state and Darjeeling district (West Bengal state), three in Andaman Islands, and two each in Jammu & Kashmir and Manipur. Nine of the 46 species known from India are endemic to the subcontinent: *Cetraria ambigua*, *C. stracheyi*, *Nephromopsis hypotrachyna*, *N. isidioidea*, *N. leucostigma*, *N. melaloma*, *N. nephromoides*, *N. stracheyi,* and *N. sikkimensis*.

Nephromopsis awasthii is proposed here as a new species, based on a morphological analysis. However, there is a need for molecular evidence and additional specimens for comparing infra-species variation and for confirming the generic position. *Cetraria endochrysea*, *C. sinensis*, *Melanelia agnata*, *Nephromopsis ciliaris*, *N. morrisonicola*, *N. pseudocomplicata*, *N. pseudoweberi*, *N. rugosa*, *N. weii,* and *N. yunnanensis* are new distributional records for India.

Most cetrarioid species are corticolous or terricolous, although a few species of *Melanelia* and *Nephromopsis* are saxicolous (Thell 1996). The species growing on soil and rocks form cushions and grow in association with mosses and grasses. Cetrarioid lichens occur primarily in the temperate and alpine regions of India, although some species such as *Cetraria oakesiana, Nephromopsis laii,* and *N. stracheyi* are restricted to lower altitudes between 500–1500 m. The middle altitudinal range (1500–3500 m) in Western and Eastern Himalayan regions are preferred by *Nephromopsis hypotrachyna, N. laii, N. melaloma, N. togashii,* and *N. weii,* which are found growing luxuriantly on various trees such as *Acer oblongum*, *Pinus roxburghii, Quercus oblongata, Juglans regia*, and *Rhododendron* spp. The higher altitude region (>3500 m) in Arunachal Pradesh, Sikkim, and Uttarakhand mostly lacks trees but is characterized by shrubs and grasslands. Here, the cetrarioid lichens mainly grow on rock, soil and branches of shrubs. The common saxicolous cetrarioid lichens (*Melanelia* sp. and *Cetraria* sp.) are also found growing here on exposed boulders. The flat tops of boulders are generally covered with small bushes that provide shade where cetrarioid lichens grow along with grasses and other herbaceous plants. *Cetraria muricata*, *C. nigricans*, *Nephromopsis*

cucullata, and *N. nivalis* occur on soil along the boulders together with grasses and herbs, and small shrubs are often covered with *Nephromopsis hypotrachyna.*

Key to the genera of cetrarioid lichens

1. Pseudocyphellae, if present, occur on both sides 2
1. Pseudocyphellae lacking or sometime present on one side 3
2. Thallus saxicolous, foliose, brown, lobes narrow, sometimes pseudocyphellate; ascospores simple; pycnoconidia bifusiform, cylindrical or fusiform ... ***Melanelia***
2. Thallus terricolous or corticolous, foliose or subfruticose, yellowish grey or straw yellow or brown, lobes wide or narrow, often pseudocyphellate; ascospores globose, subglobose or ellipsoid; pycnoconidia, apical, subapical, swellings, dumb-bell to disc-bar shaped or bacilliform ..... ***Nephromopsis***
3. Thallus foliose, reticulately ridged and veined, pseudocyphellae present on upper surface; thallus containing caperatic acid ..... ***Platismatia***
3. Thallus fruticose, smooth, pseudocyphellae present or absent, if present then marginal or laminal on lower surface and rare on upper surface; thallus containing other lichen substances ..... ***Cetraria***

Cetraria Ach., Meth. Lich.: 292. 1803

Thallus fruticose to subfruticose or caespitose, rarely appressed foliose, several individual thalli usually clumped together into small stands, dorsiventral; lobes subterete, canaliculate to flat, dichotomously or irregularly branched, expanded portions often unbranched; margins usually entire, sometimes undulating or cucullate; marginal projections and cilia present in some; upper surface grey, olive green, brown to reddish brown, emaculate, with or without soredia, lacking isidia; upper cortex bilayered, with a non-pored epicortex; with or without pseudocyphellae, pseudocyphellae marginal or laminal on lower surface, rare on upper surface; without rhizines; medulla white. Apothecia usually submarginal close to lobe apices, sessile to subpedicellate; disc perforate; asci clavate to cylindrical, 8-spored, spores ellipsoidal to subspherical, 6–10 × 3–5 μm. Pycnidia common to rare, at ends of marginal projections; pycnoconidia oblong to citriform, sublageniform or filiform shape.

The genus *Cetraria* is represented by 38 species worldwide (Randlane & al. 2013) of which 16 are known from India, mostly distributed in the alpine region of the Indian Himalayas.

Key to the species of genus *Cetraria* from India

1. Thallus containing usnic acid 2
1. Thallus lacking usnic acid 10

2. Medulla bright yellow or orange 3
2. Medulla white, occasionally pale yellow 4
3. Thallus fruticose, yellowish brown; containing usnic acid in cortex, hybocarpone and secalonic acids ..... *C. endochrysea*
3. Thallus foliose, bright yellow; containing pinastric and vulpinic acids ... *C. pinastri*
4. Thallus terricolous or saxicolous, lobe margins without soredia 5
4. Thallus corticolous, lobe margins with soralia ..... *C. oakesiana*
5. Medulla white 6
5. Medulla yellow to ochraceous. 9
6. Thallus containing fumarprotocetraric acid; medulla P+ orange red ..... *C. flavonigrescens*
6. Thallus containing other lichen substances; medulla P– 7
7. Thallus containing lichesterinic, protolichesterinic, and secalonic acids 8
7. Thallus containing lichesterinic, protolichesterinic, and caperatic acids .. *C. denticulata*
8. Lobes wider, ≤3 mm, upper surface yellowish to grey green; pseudocyphellae lined continuously along the margins on the underside ..... *C. sinensis*
8. Lobes narrower ≤2 mm, upper surface yellow to ochraceous; pseudocyphellae punctiform..... *C. ambigua*
9. Lobes distinctly dorsiventral, upper side concave, secondary lobes present ..... *C. globulans*
9. Lobes radially symmetrical, upper side convex, secondary lobes absent ..... *C. laii*
10. Thallus containing fumarprotocetraric acid, medulla K+ yellow then red, P+ reddish 11
10. Thallus containing other lichen substances, medulla K-, P- 12
11. Lobes canaliculate to strongly tubular; pseudocyphellae submarginal, forming a distinct continuous line ..... *C. laevigata*
11. Lobes flat to canaliculate; pseudocyphellae laminal to submarginal, but not in continuous lines ..... *C. islandica*
12. Thallus 1–2 cm tall, shrubby tuft, branched, lobes 0.5–1.5 mm wide 13
12. Thallus more than 2 cm tall, intricately branched, lobes >1.5 mm wide 15
13. Pseudocyphellae present 14
13. Pseudocyphellae absent ..... *C. sepincola*
14. Pseudocyphellae flat and circular; pycnidia on spinules; apothecia not seen ..... *C. muricata*
14. Pseudocyphellae present in form of white dots; pycnidia at lobe margins, apothecia present; ascospores ellipsoidal, 7 × 4.5 µm ..... *C. odontella*
15. Pseudocyphellae distinct, marginal projections absent; medulla hollow ... *C. aculeata*
15. Pseudocyphellae very narrow to indistinct, marginal projections sparse; medulla solid ..... *C. nigricans*

Cetraria aculeata (Schreb.) Fr., Nov. Sched. Critic. Lich.: 32 (1826)

≡ *Lichen aculeatus* Schreb., Spic. Fl. Lips.: 125 (1771)

Thallus fruticose, terricolous, branched, ≤4–6 cm tall, in tuft; lobes 3.5 mm wide; upper surface olive black, smooth, marginal projections absent; lacking isidia and soredia; lower side light black, with deeply concave pseudocyphellae, concave; medulla hollow. Apothecia rare. Pycnidia not seen.

Chemistry—Medulla K–, C–, P–, KC–; protolichesterinic acid present in TLC.

Specimen examined—**INDIA, Uttarakhand, Uttarkashi district**, Gomukh area, alt. 3200–3800 m, on soil, D.D. Awasthi & S.R. Singh s.n. (LWG-AWAS).

Remarks—*Cetraria aculeata,* which is closely related to *C. muricata,* is generally distinguished by its hollow medulla and deeply concave pseudocyphellae.

Ecology & distribution—*Cetraria aculeata* occurs on soil reaching elevations up to ca. 3800 m and has been reported from the western Himalaya region of Uttarakhand.

Cetraria ambigua C. Bab., Hooker's J. Bot. Kew Gard. Misc. 4: 244 (1852)

≡ *Allocetraria ambigua* (C. Bab.) Kurok. & M.J. Lai, Bull. Natl. Sci. Mus. Tokyo, B 17(2): 62 (1991)

Thallus foliose to subfruticose, terricolous, prostrate to erect, ≤1.5–3 cm tall, branched; lobes ≤1–2 mm wide; upper surface yellow to ochraceous, plane to concave, smooth; lacking isidia and soredia; lower side slightly brownish, ± longitudinally reticulately lacunose scrobiculate, with marginal punctiform pseudocyphellae; medulla white. Apothecia rare, marginal to submarginal, ascospores ellipsoid, 7–9 × 4–5 µm. Pycnidia present, marginal; pycnoconidia not found.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex, lichesterinic, protolichesterinic, and secalonic acids present in TLC.

Specimens examined—**INDIA, Himachal Pradesh, Lahul Spiti district**, Baralachala pass, alt. 4700 m, on soil, 4.8.2003, D.K. Upreti & S. Chatterjee 03-001780 (LWG). **Sikkim, North Sikkim**, Donkia, alt. 5200 m, U. Lachungpa 1746 (LWG-LWU), Llonakh valley, Muguthang to Naku La, alt. 4500–4600 m, on soil, Sinha 1583 (BSHC), Yangdi, above Thangu, alt. 4250 m, on bark, 13.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divaker 04-003981/A, 04-003951 (LWG). **Uttarakhand, Uttarkashi district**, Gomukh area right bank, 5th Moraine, alt. 4200 m, on soil, 4.6.1976, D.D. Awasthi & S.R. Singh 8521 (LWG-AWAS), Govind Wildlife Sanctuary, on way to Morinda Tal, alt. 3695 m, on soil, 23.09.2013, G.K. Mishra s.n. (LWG).

Remarks—*Cetraria denticulata,* which is similar to *C. ambigua* in having a white medulla, differs in having punctiform pseudocyphellae and secalonic acid present in the thallus.

Ecology & distribution—*Cetraria ambigua* grows on soil in open shady places between 3695–5200 m and is widely distributed in alpine regions of Himachal Pradesh, Sikkim, and Uttarakhand.

Cetraria denticulata Hue, Nouv. Arch. Mus. Hist. Nat., sér. 4, 1: 85 (1899), nom. illeg., non La Lave (1820)

≡ *Allocetraria denticulata* A. Thell & Randlane, Flechten Follmann: 359 (1995)

Thallus foliose, terricolous or saxicolous, prostrate to erect, ≤2.5–3 cm tall, branched; lobes ≤1.5 mm wide; upper surface greenish yellow, smooth, plane to convex; lacking isidia and soredia; lower side slightly brown or similar to upper surface; medulla white;. Apothecia absent. Pycnidia marginal, emergent, projecting, black; pycnoconidia filiform, 12–15 × 1 μm.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex, lichesterinic, protolichesterinic, and caperatic acids present in TLC.

Remarks—*Cetraria denticulata* is similar to *C. flavonigrescens,* which differs chemically with usnic acid in the cortex and lichesterinic, protolichesterinic, and caperatic acids present in thallus.

Ecology & distribution—*Cetraria denticulata,* which is reported from the alpine region of Sikkim at 4200 m, is rare in India and known only from north Sikkim. The specimen at LWG is not available/found and the description and chemistry are based on Sinha & Singh (2005).

Cetraria endochrysea (Lynge) Divakar, A. Crespo & Lumbsch, Fung. Divers. 84: 111 (2017) Fig. 2a,b

≡ *Dactylina endochrysea* Lynge, Skr. Svalbard Ishavet 59(Suppl. 5): 62 (1933)

Thallus fruticose, terricolous, erect, ≤1–2 cm tall, branched; lobes ≤2 mm wide, sometimes apically almost radially symmetrical; upper surface yellow to pale brownish, convex; margin with black pycnidial papillae; lacking pseudocyphellae, isidia and soredia; lower surface yellow to reddish brown, concave; medulla yellow to orange. Apothecia absent. Pycnidia emergent, pycnoconidia not found.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; hybocarpone and secalonic acids present in TLC.

Specimens examined—**INDIA**, **Uttarakhand**, **Uttarkashi district**, Govid Wildlife Sanctuary, around Morinda Tal, alt. 3695 m, on soil, D.K. Upreti & R. Bajpai 12-011472, 12-018550 (LWG).

Remarks—In thallus morphology and medulla colouration, *Cetraria endochrysea* is close to *C. stracheyi,* which lacks hybocarpone acid. Similarly, *C. endochrysea* morphologically resembles *C. globulans,* which differs in having

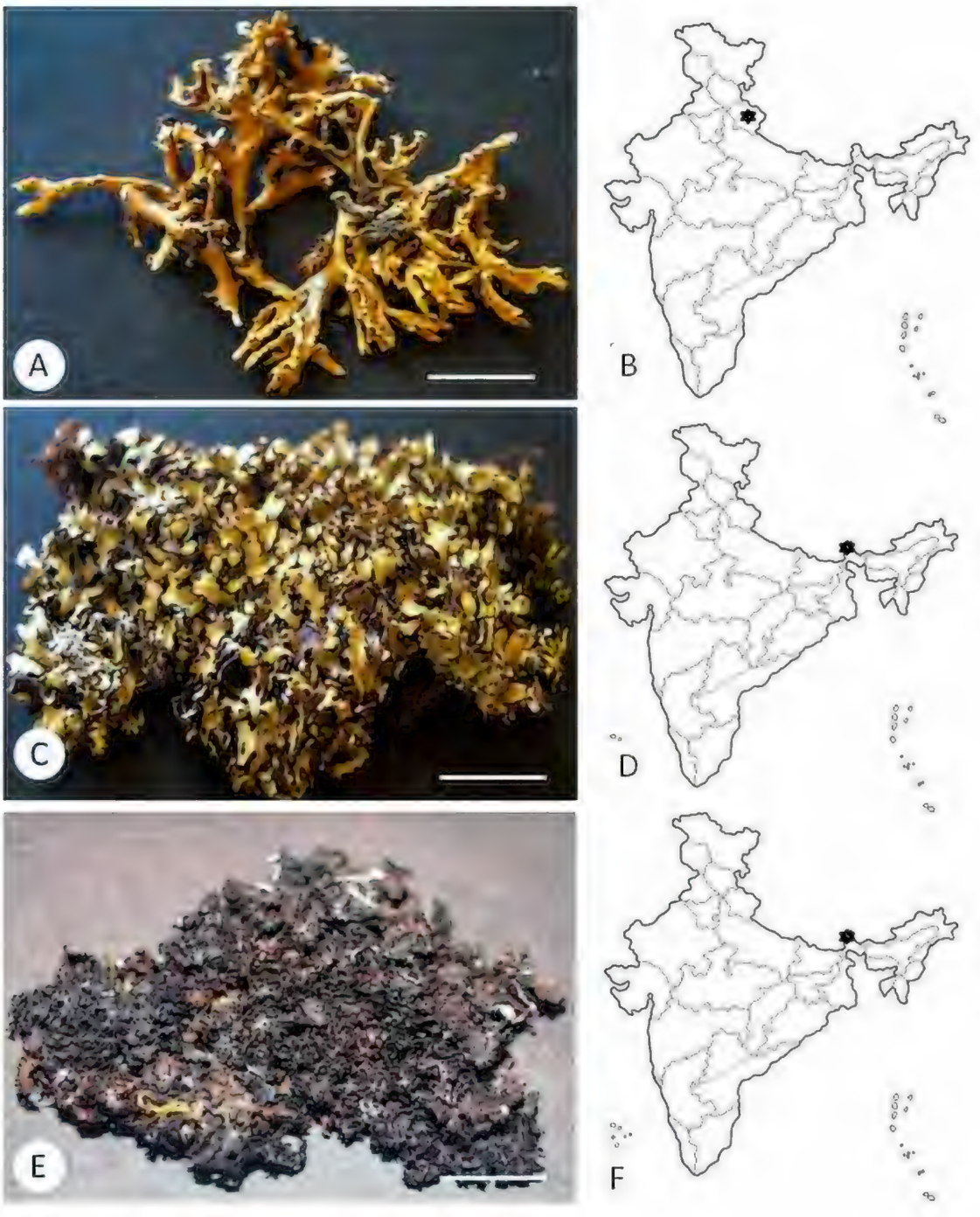

Fig. 2. ***Cetraria endochrysea*** (LWG 12-011472). A. habit; B. Indian distribution. ***Cetraria sinensis*** (LWG 16-037821). C. habit; D. Indian distribution. ***Melanelia agnata*** (LWG 15-026539). E. habit; F. Indian distribution. Scale bars: A, C, E = 1 cm.

a white to pale yellow medulla and the presence of numerous pycnidia along the margin. Previously this species was reported from China (Wei 1991; Kärnefelt & Thell 1996). This is the first record from India.

Ecology & distribution—*Cetraria endochrysea* is common on soil, growing at 3695 m in the alpine region of Uttarakhand.

Cetraria flavonigrescens (A. Thell & Randlane) Divakar, Crespo & Lumbsch, Fungal Diversity 84: 111 (2017)

≡ *Allocetraria flavonigrescens* A. Thell & Randlane, Flechten Follmann: 359 (1995)

Thallus foliose to subfruticose, saxicolous, dorsiventral loosely attached, ≤4 cm across, branched; lobes ≤2 mm wide, linear to laciniate; margin brown; upper surface yellowish with black spots, dull, faintly lacunose, plane to convex, with numerous 1–2 mm tall reticulate maculae; lacking pseudocyphellae, isidia and soredia; lower surface dark brown to black, pale at margins, wrinkled medulla white; rhizines present. Apothecia not seen. Pycnidia emergent, black, marginal to submarginal; pycnoconidia filiform, 12–16 × 1–1.8 µm.

Chemistry—Medulla K–, C–, P+ orange, KC–; usnic acid in cortex, fumarprotocetraric acid present in TLC.

Specimens examined—**INDIA**, **Sikkim**, **North Sikkim,** Lonakh valley, Muguthang to Nakula track, alt. 4500 m, on boulders, 1.9.1999, G.P. Sinha 1575 (BSHC). **Uttarakhand**, **Uttarkashi district**, Bhojwasa, alt. 3700 m, on bark, 5.9.2002, S. Chatterjee & P.K. Divakar 02-000205 (LWG), Gomukh right bank, 4th moraine near Gomukh, alt. 3810 m, 3.07.1976, D.D. Awasthi & S.R. Singh 8438 (LWG-AWAS).

Remarks—*Cetraria flavonigrescens* is similar to *C. ambigua,* which differs primarily in chemistry, with usnic acid in the cortex and lichesterinic, protolichesterinic, and secalonic acids in the medulla.

Ecology & distribution—This species is found only in alpine regions of Sikkim and Uttarakhand between 3700 and 4500 m.

Cetraria globulans (Nyl.) Zahlbr., Trav. de la Sous-Sect. Troïtzkossawsk-Khiakta, Sect. du Pays d'Amour de la Soc. Imp. Russe de Géogr. 12: 89 (1910) ["1909"]

≡ *Platysma globulans* Nyl., Flora 70: 134 (1887)

≡ *Allocetraria globulans* (Nyl.) A. Thell & Randlane, Flechten Follmann: 360 (1995)

Thallus foliose, corticolous or terricolous, branched, ≤3 cm tall; lobes ≤8 mm wide with narrow secondary lobes 1–1.5 mm wide; upper surface yellow to pale brown, plane to concave; pseudocyphellae, isidia, and soredia lacking; lower surface brown with sparse concolorous rhizines; medulla white to pale yellow. Apothecia not seen. Pycnidia numerous, marginal to laminal, located on black, emergent projections; pycnoconidia 10–18 × 0.5–2 µm.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; lichesterinic, protolichesterinic, and secalonic acids present in TLC.

Specimens examined—**INDIA**, **Sikkim**, **North Sikkim**, Lonakh valley, Muguthang to Nakula, alt. 4500 m, on soil, 01.9.1999, G.P. Sinha 1571B (BSHC), Giagaon above,

Thangu, alt. 4600 m, on bark, 13.08.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004005, 04-004012 (LWG).

Remarks—*Cetraria globulans* is closely related with *C. stracheyi,* which differs in having a yellow and convex upper surface.

Ecology & distribution—*Cetraria globulans* grows on alpine areas of North Sikkim at 4500–4600 m and is known only from North Sikkim in eastern Himalaya.

Cetraria islandica (L.) Ach., Methodus: 293 (1803)

≡ *Lichen islandicus* L., Sp. Pl. 2: 1145 (1753)

Thallus fruticose, terricolous, divaricately branched, suberect to erect, ≤6.5 cm thick; lobes 2–5 mm wide, involute subcanaliculate; upper surface light to chestnut brown, smooth, margins with dense brown to brown black pycnidial fibrils; pseudocyphellae present, laminal to submarginal, whitish, laminal ones rounded to irregular, submarginal ones linear elongate, scarce; isidia and soredia absent; lower surface yellowish brown to brown, smooth to scrobiculate, shining to dull, pseudocyphellae not seen on lower side; medulla white, solid. Apothecia & Pycnidia not seen in the examined material (but frequent in the Northern Hemisphere).

Chemistry—Medulla K– or K+ pale to reddish, C–, P+ red, KC–; fumarprotocetraric, protocetraric and protolichesterinic acids present in TLC.

Specimens examined—**INDIA**, **Himachal Pradesh**, **Kullu district**, Great Himalayan National Park, Around Soupdhar, alt. 3900 m, on soil, 7.9.1999, D.K. Upreti 99-53675/B (LWG). **Sikkim**, **North Sikkim**, Sebu La base camp, east side, alt. 4960 m, on soil, G.P. Sinha 1236 (BSHC), Theu La-Jakthang way, alt. 4600 m, on soil, G.P. Sinha 1713 (BSHC). **Uttarakhand**, **Bageshwar district**, above Phurkia to Mirtoli, alt. 3200 m, on soil, 12.6.1970, D.D. Awasthi 7792 (LWG-AWAS), on way to Pindari Glacier, alt. 3350 m, on soil, 12.6.1970, D.D. Awasthi 7652 (LWG-AWAS), 23.5.1950, D.D. Awasthi 781 (LWG-AWAS), ridge of moraine above Pindari Glacier near zero mile, alt. 4000 m, on soil, 11.6.1970, D.D. Awasthi 7682 (LWG-AWAS); **Chamoli district**, Badrinath between, Vasundhara & Bhagirathi Glacier, alt. 3900-4500 m, on soil, 9.9.1991, D.K. Upreti L13207, L13206/B (LWG), Chopta Tungnath, on soil, October 1994, H.R. Negi L2315 (LWG), Between Wan & Bhuna, alt. 3300 m, on soil, 23.10.1967, A. Singh 91128/A (LWG); **Uttarkashi district**, Gomukh area, right bank, 3rd Moraine, alt. 4200 m, on soil, 3.6.1976, D.D. Awasthi & S.R. Singh 84.25, 24.90 (LWG-AWAS).

Remarks—*Cetraria islandica* is closely related to *C. laevigata,* which differs in having wider lobes and more distinct laminal pseudocyphellae.

Ecology & distribution—*Cetraria islandica* occurs on soil between altitudes of 3800–4960 m and is the most common and widely distributed *Cetraria* species in India. It has been reported from several localities in

Himachal Pradesh, Sikkim, and Uttarakhand, but is more frequently collected from the western Himalayas.

Cetraria laevigata Rass., Bot. Zh. SSSR 28: 79 (1943)

Thallus fruticose, terricolous, suberect to erect, ≤2.5–6 cm tall, sparsely branched; lobes 3 mm wide, canaliculate to subtubular; upper surface brown to chestnut brown, smooth, margin with brown to black pycnidial fibrils; pseudocyphellae present, distinct, in whitish continuous lines, particularly along tips; isidia and soredia lacking; lower surface light brown, with pseudocyphellae marginal as a continuous line or invisible due to strongly canaliculate tubular nature; medulla white. Apothecia & Pycnidia not seen in the examined material (but frequent in the Northern Hemisphere).

Chemistry—Medulla K+ yellowish or K–, C–, P+ red, KC–; fumarprotocetraric, protocetraric and protolichesterinic acids present in TLC.

Specimens examined—**INDIA, Arunachal Pradesh, West Kameng district**, Bomdila-Sela, Sela Pass, alt. 3600 m, on soil, 18.11.2008, D.K. Upreti, U. Dubey, G.K. Mishra & R. Khare 09-009436 (LWG). **Sikkim, North Sikkim**, Llonakh valley, Chhaber lake below Luna La, alt. 4600 m, on soil, G.P. Sinha 1607 (BSHC), on way between Lashar and GSI old Camp Hut, alt. 4400 m, on soil, Sinha 1202 (BSHC), Yomesamdong, Tembawa river valley, alt. 4750 m, on soil, G.P. Sinha 1261 (BSHC), Yumthang, along river side forest, alt. 3530 m, on soil, G.P. Sinha 1081 (BSHC).

Remarks—*Cetraria laevigata* resembles *C. islandica* but differs in having more tubular lobes.

Ecology & distribution—*Cetraria laevigata* is known to be terricolous, occurring at ca. 3500–4750 m and is reported from eastern Himalaya from different localities of Arunachal Pradesh, and Sikkim.

Cetraria laii Divakar, A. Crespo & Lumbsch,
Fung. Divers. 84: 111 (2017), non *Cetraria stracheyi* C. Bab. (1852)
≡ *Evernia stracheyi* C. Bab., Hooker's J. Bot. Kew Gard. Misc. 4: 244 (1852)
≡ *Allocetraria stracheyi* (C. Bab.) Kurok. & M.J. Lai, Bull.
Nat. Sci. Mus. Tokyo, B 17: 62 (1991)

Thallus fruticose, terricolous, suberect to erect, caespitose, ≤2–2.5 cm tall, branched; lobes ≤2 mm wide, sometimes apically almost radially symmetrical; upper surface yellow grey to brownish, convex; isidia and soredia absent; lower surface also yellow to reddish brown, concave, lacunose to scrobiculate; medulla yellow to ochraceous; margin with black pycnidial papillae. Apothecia rare, marginal to submarginal, ≤2–6 mm in diam., ascospores 5–7 × 4.5 µm. Pycnidia not seen.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex, lichesterinic, protolichesterinic, and secalonic acids present in TLC.

Specimens examined—**INDIA, Jammu & Kashmir, Ladakh district,** Hemis National Park, Rumbak Valley, Tiblis, alt. 4600 m, on bark, 26.7.1999, H.R. Negi L19 (LWG). **Sikkim, North Sikkim**, on way between Lashar and GSI old camp hut, alt. 4400 m, Sinha 1197 (BSHC), Sebu La base camp, west side, alt. 4800 m, Sinha 1210 (BSHC), Llonakh valley, Chhaber lake below Luna La, alt. 4600 m, on soil, G.P. Sinha 1614 (BSHC), on midway between Thangu and Lashar, alt. 4300 m, on soil, G.P. Sinha 1171 (BSHC), Yomesamdong Hot spring surroundings, alt. 4530 m, on soil, G.P. Sinha 1253 (BSHC), Yomesamdong, Tembawa river valley, alt. 4750 m, on soil, G.P. Sinha 1260 (BSHC), Giagaon above, Thangu, alt. 4600 m, on bark, 13.08.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004005 (LWG), Yangdi after Thangu, alt. 4250 m, on rocks, 13.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-003953 (LWG). **Uttarakhand, Bageshwar district**, on way to Phurkia to Mirtoli, alt. 4000 m, on rock, 12.6.1970, D.D. Awasthi 7744 (LWG-AWAS), 23.5.1950, D.D. Awasthi & A.M. Awasthi 781 (LWG-AWAS); **Uttarkashi district**, Gomukh area right bank, 5th Moraine, alt. 4200 m, on soil, 4.7.1976, D.D. Awasthi & S.R. Singh 8527, 8473 (LWG-AWAS), Govind Wildlife Sanctuary, enroute to Morinda Tal, Harki-Dun, alt. 3643, on rock, 12.6.2012, D.K. Upreti & R. Bajpai 12-016184, 12-018553 (LWG).

Remarks—*Cetraria laii* is one of the most common *Cetraria* species in India. In the presence of secalonic acid, *C. laii* is similar to *C. ambigua,* which is distinguished by its distinctly concave lobes (unlike the dorsiventral lobes with the convex upper surface that characterize *C. laii*).

Ecology & distribution—*Cetraria laii* grows abundantly on soil in the alpine region at 4000–4800 m and is distributed in Jammu & Kashmir, Sikkim, and Uttarakhand.

Cetraria muricata (Ach.) Eckfeldt, Bull. Torrey Bot. Club 22: 240 (1895)

≡ *Lichen muricatus* Ach., Lichenogr. Suec. Prodr.: 214 (1798)

≡ *Cornicularia muricata* (Ach.) Ach., Methodus: 302 (1803)

Thallus fruticose, terricolous, shrubby tufts, terete, ≤2 cm tall, densely branched and spinulose; main branches rounded to somewhat flattened; lobes 0.5–1 mm wide, usually with numerous small lateral spinules; upper surface matte to glossy brown, with oval-elliptic, plane, white pseudocyphellae; marginal cilia sparse; isidia and soredia absent; lower surface tan to brown; medulla white, solid. Apothecia not seen. Pycnidia on spinules; pycnoconidia oblong to citriform, 5–6 × 1–1.5 μm.

Chemistry—Medulla K–, C–, P–, KC–; protolichesterinic and rangiformic acids present in TLC.

Specimens examined— **INDIA, Sikkim, North Sikkim**, Theu La bae camp, south side, alt. 4500 m, on soil, G.P. Sinha 1697 (BSHC). **Uttarakhand, Uttarkashi district,**

Govind Wildlife Sanctuary, Har-ki-Dun, Morinda Tal alt. 3695 m, on rock, D.K. Upreti & R. Bajpai 12-011475 (LWG), Gomukh area, right bank, 5th moraine, alt. 4200 m, on soil, 4.7.1976, D.D. Awasthi & S.R. Singh 8488 (LWG-AWAS).

Remarks—*Cetraria muricata* morphologically resembles *C. aculeata,* which differs in having a differently shaped thallus and larger lobes.

Ecology & distribution—This species grows in the Eastern and Western Himalayas in Sikkim and Uttarakhand states at 4000–4500 m.

Cetraria nigricans Nyl., Herb. Musci Fenn.: 109 (1859)

Thallus fruticose, terricolous, ≤3 cm tall, subdichotomously branched; lobes ≤1–2 mm wide, rarely canaliculate; upper surface dark brown to black, marginal projections sparse, 0.25–0.5 mm long pycnidial fibrils and 0.5–1 mm long cilia; pseudocyphellae almost barely visible; rarely sorediate; isidia absent; lower surface pale brown to brown; marginal pseudocyphellae very narrow to indistinct; medulla white. Apothecia ≤10 mm in diam., ascospores 5 × 2.5 µm. Pycnidia not seen.

Chemistry—Medulla K–, C–, P–, KC–; lichesterinic and protolichesterinic acids present in TLC.

Specimens examined—**INDIA, Sikkim, North Sikkim district,** Yangdi, above Thangu, alt. 4250 m, on bark, 13.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-003974, 04-003976, 04-003891, 04-003919, 04-003970 (LWG), Thangu area, alt. 4000 m, on bark, 12.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-003891(LWG), Yangdi above, Thangu, alt. 4250 m, on soil, 13.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-003976, 04-003970, 04-003974 (LWG), Chubuk above, Thangu, alt. 4100 m, on soil, 13.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-003919 (LWG). **Uttarakhand, Bageshwar district**, above Phurkia to Mirtoli, alt. 3200 m, on soil, 12.6.1970, D.D. Awasthi 7799 (LWG-AWAS); **Chamoli district**, near Badrinath way from Mana to Vasudhara, alt. 3350 m, on soil, 21.8.2007, D.K. Upreti & S. Nayaka 07-010128 (LWG), 10 km before Neeti, alt. 3118 m, on soil, 20.8.2007, D.K. Upreti & S. Nayaka 07-01013 (LWG), Badrinath between Vasundhara, alt. 3350 m, on soil, 21.7.2007, D.K. Upreti & S. Nayaka 07-010128 (LWG), 10 km, before Neeti, alt. 3118 m, on soil, 20.8.2007, D.K. Upreti & S. Nayaka 07-010103 (LWG); **Pithoragarh district**, above Phurkia to Mirtoli, alt. 3800 m, on soil, 12.6.1970, D.D. Awasthi 7799 (LWG-AWAS); **Uttarkashi district**, Govind Wildlife Sanctuary, near Har-ki-Dun, alt. 3513 m, on rock, 12.6.2012, D.K. Upreti & R. Bajpai 12-018544 (LWG).

Remarks—*Cetraria nepalensis,* which also has a pseudocyphellate thallus and marginal cilia differs from *C. nigricans* in having short cilia and wider lobes.

Ecology & distribution—*Cetraria nigricans* is widely distributed in alpine areas of Himalayas at 3118–4200 m. Previously known only from Sikkim (Singh & Sinha 2010), the present study extends its distribution to Uttarakhand.

Cetraria oakesiana Tuck., Boston J. Nat. Hist. 3: 445 (1841)

≡ *Usneocetraria oakesiana* (Tuck.) M.J. Lai & J.C. Wei, J. Natl. Taiwan Mus. 60(1): 58 (2007)

Thallus foliose to subfoliose, corticolous, ≤4 cm across; lobes 1-4 mm wide; upper surface yellowish green; soredia present, marginal, farinose; without pseudocyphellae; soredia present and isidia absent; lower surface white to brownish, lacking pseudocyphellae, with a few scattered rhizines; rhizines, simple, black, 0.5–0.8 mm long; medulla white. Apothecia not seen. Pycnidia marginal, often at the edge of soralia apical on ≤0.5 mm long; pycnoconidia filiform, slightly thicker at one end, c. 9–10 × 1 µm.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; lichesterinic, protolichesterinic, and secalonic acids present in TLC.

Specimen examined—**INDIA, Uttarakhand, Pithoragarh district**, Binsar forest, alt. 1450 m, on bark, May 2006, S. Bhatt 06-010845/B (LWG).

Remarks—In having marginal soralia, *C. oakesiana* is morphologically similar to *Nephromopsis laureri,* which differs in its thinner, more ascending lobes with scattered pseudocyphellae on the lower side and ≤5 µm long bifusiform pycnoconidia.

Ecology & distribution—*Cetraria oakesiana* has restricted distribution in Uttarakhand, occurring on bark at 1450 m.

Cetraria odontella (Ach.) Ach., Syn. Meth. Lich.: 230 (1814)

≡ *Lichen odontellus* Ach., Lichenogr. Suec. Prodr.: 213 (1798)

≡ *Cornicularia odontella* (Ach.) Röhl., Deutschl. Fl. 3 Abt. 2: 141 (1813)

Thallus fruticose, terricolous, loosely attached, erect, densely branched ≤0.5–2 mm tall; lobes ≤0.3–1.5 mm wide; both cilia and marginal projections which bear pycnidia are present along the margins of the lobes; cilia 0.3–0.8 mm; upper and lower surfaces pale brown to brown (dark brown in the older basal parts, pale brown to reddish brown above); pseudocyphellae present in the form of small white dots; isidia and soredia lacking; medulla white. Apothecia ≤10–15 mm wide, asci 30 × 8 µm, ascospores ellipsoidal 7 × 4.5 µm. Pycnidia marginal; pycnoconidia oblong-citriform to slightly bifusiform ca. 3.6–4.8 × 0.5 µm.

Chemistry—Medulla K–, C–, P–, KC–; No lichen substance present in TLC.

Specimen examined—**INDIA, Uttarakhand, Uttarkashi district**, Gomukh area right bank, 5th and 6th moraines, alt. 3780 m, on soil, 4.7.1976, D.D. Awasthi & S.R. Singh s.n. (LWG-AWAS).

Remarks—*Cetraria odontella* is similar to *C. nigricans* in bearing pseudocyphellae and marginal cilia, but *C. nigricans* has wider lobes and a taller (≤3 mm) thallus.

Ecology & distribution—*Cetraria odontella* was found on soil at 3780 m, so far collected only at this single locality in Uttarakhand.

Cetraria pinastri (Scop.) Gray, Nat. Arr. Brit. Pl. 1: 432 (1821)

≡ *Lichen pinastri* Scop. Fl. carniol., Edn 2 (Wien) 2: 382 (1772)

≡ *Vulpicida pinastri* (Scop.) J.-E. Mattsson & M.J. Lai, Mycotaxon 46: 428 (1993)

Thallus foliose, corticolous, loosely appressed to the substratum, 1–3 cm across; lobes narrow, imbricate, 2–4 mm wide, flat or slightly canaliculate with short branches; margin undulate; upper surface bright yellow to yellowish green, smooth, with marginal soralia, occasionally spreading to submarginal parts; soredia farinose, yellow; isidia and soredia lacking; lower surface grayish to brownish, lamellose rugose with dark brown; rhizines present, 1–2 mm long; medulla yellow. Apothecia marginal to submarginal, 1–4 mm diam., margin weakly crenulate sorediate, disc concave, dark brown, shiny; asci broadly clavate 25–35 × 10–12 µm, ascospores spherical 10–12 × 5–8 µm. Pycnidia rare, on projection; pycnoconidia pyriform to almost spherical 80–120 × 70–100 µm.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in the cortex; pinastric and vulpinic acids in TLC.

Specimens examined—**INDIA**, **Jammu & Kashmir**, **Baramulla district**, Gulmarg, North side of Gulmarg, alt. 2520 m, on bark, 24.7.2005, M. Sheikh 05-006030 (LWG). **Himachal Pradesh**, **Kinnaur district**, Chhitkul forest area, alt. 3900–4000 m, on bark, 4.11.2003, D.K. Upreti, R. Srivastava & P. Singh 03-002718, 03-002737, 03-002746 (LWG), 11.5.2014, G.K. Mishra s.n. (LWG). **Uttarakhand**, **Chamoli district**, Malari, alt. 3000 m, on bark, 28.6.2007, S. Rawat 07-008622 (LWG), way to Niti, 10 km before Gamsali, alt. 3300 m, on bark, 20.8. 2007, D.K. Upreti & S. Nayaka 07-011206 (LWG); **Uttarkashi district**, on way to Gomukh, 11 before Gangotri, alt. 11600ft., on bark, 30.6.1976, D.D. Awasthi & S.R. Singh 8360, 8327, 8285, 8597 (LWG-AWAS), Gomukh area right bank, 6th moraine, alt. 4100 m., on bark, 5.7.1976, D.D. Awasthi & S.R. Singh 8554 (LWG-AWAS).

Remarks—*Cetraria pinastri* is easily recognized by its characteristic yellow colour and sorediate lobe margins. *Cetraria pinastri,* which is closely related to *C. juniperina* (L.) Ach. in having similar chemistry, presence of pinastric and vulpinic acids, but *C. juniperina* lacks soredia.

Ecology & distribution—*Cetraria pinastri* commonly grows on bark at 2500–4000 m in Jammu & Kashmir, Himachal Pradesh, and Uttarakhand.

Cetraria sepincola (Hoffm.) Ach., Meth. Lich.: 297 (1803)

≡ *Lichen sepincola* Ehrh., Pl. crypt. exsicc.: no. 90 (1785)

≡ *Tuckermannopsis sepincola* (Hoffm.) Hale, Bryologist 90: 164 (1987)

Thallus foliose to subfruticose, corticolous, orbicular, 1–1.7 cm across; lobes radiating, irregularly incised or rounded, 1–2.5 mm wide; upper surface olive brown or ashy brown, smooth, dull; isidia and soredia lacking; lower surface pale brown, weakly wrinkled; rhizines pale, simple, scattered; medulla white. Apothecia abundant, submarginal, 1–3 mm across; disc red brown, shining, epruinose, ascospores simple, ellipsoid, 5.3–6.4 × 4–5 μm. Pycnidia numerous; pycnoconidia not seen.

Chemistry—Medulla K–, C–, P–, KC–; protolichesterinic acid present in TLC.

Specimen examined—**INDIA, Sikkim, North Sikkim**, Theu La base camp, south side, alt. 4500 m, on *Rhododendron* bark, G.P. Sinha 1682 (BSHC).

Remarks—*Cetraria sepincola* forms shrubby tufts, lacking pseudocyphellae and rhizines and resembles *Nephromopsis chlorophylla* in having protolichesterinic acid, but *N. chlorophylla* differs in having soredia and a yellowish brown upper surface.

Ecology & distribution—*Cetraria sepincola,* which grows on *Rhododendron* bark at 4500 m, is rare in India and reported only from north Sikkim. Since the specimen has not been located, the description is based on Sinha & Singh (2005).

Cetraria sinensis (X.Q. Gao) Divakar, A. Crespo & Lumbsch, Fungal Diversity 84: 111 (2017) Fig. 2c,d

≡ *Allocetraria sinensis* X.Q. Gao, Flechten Follmann: 365 (1995)

≡ *Usnocetraria sinensis* (X.Q. Gao) M.J. Lai & J.C. Wei, J. Natnl Taiwan Mus.60(1): 57 (2007)

Thallus fruticose, terricolous, suberect to erect, ≤2.5–5 cm tall, sparsely branched; lobes ≤3 mm wide, narrow channeled long lobes; upper surface yellowish to grey greenish, smooth, margin with brown to black pycnidial fibrils; pseudocyphellae present, distinct, as a continuous whitish line along the lower surface, particularly close to tips; isidia and soredia lacking; lower surface light brown, with pseudocyphellae, marginal in a continuous line; medulla white. Apothecia not seen. Pycnidia marginal, located on black and somewhat emergent projections; pycnoconidia 5 – 12 × 0.5 – 1.5 μm.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; lichesterinic, protolichesterinic, and secalonic acids present in TLC.

Specimen examined—**INDIA, Sikkim, North Sikkim**, Kabi-Tingda, on soil, alt. 3685 m, 18.10.2016, R. Bajpai 16-037821 (LWG).

Remarks—*Cetraria sinensis* shares similar secondary metabolites and a yellowish upper surface with *C. globulans,* which differs in lacking pseudocyphellae; *C. sinensis* is similar to *C. ambigua* in chemistry and colour of thallus, but *C. ambigua* differs in a yellowish lower surface.

Ecology & distribution—*Cetraria sinensis* occurs on soil and was recorded from a single site at 3695 m in the subalpine region of Sikkim. Previously known from China and Nepal (Wang & al. 2015), this is the first record of *C. sinensis* from India.

Melanelia Essl., Mycotaxon 7: 46 (1978)

Thallus foliose, dorsiventral, heteromerous, corticated on both surfaces; lobes narrow, often somewhat elongate, flat to rather distinctly convex or concave; upper surface with or without pseudocyphellae, brown, HNO_3–; or HNO_3 +; upper cortex paraplectenchymatous with non-pored epicortex; lower surface black; rhizines simple. Apothecia laminal, immersed lecanorine; asci 8-spored; ascospores colourless, simple. Pycnidia laminal or marginal; pycnoconidia bifusiform, cylindrical, or fusiform 6–10 × 1 µm.

Three of the four species of *Melanelia* known from the world are present in India.

Key to the species of genus *Melanelia* from India

1. Thallus upper surface glossy brownish black to greenish brown; secondary metabolites absent (all spot reactions are negative) ..... ***M. agnata***
1. Thallus upper surface greenish brown to dark brown or black; secondary metabolites present (at least some spot reactions are positive) 2
2. Thallus forming a mat-like rosette, appressed; lobes 0.5–1.5 mm wide with marginal pycnidial papillae; thalline exciple lacking retrorse hairs .. ***M. hepatizon***
2. Thallus not forming a mat, loosely appressed; lobes 0.5–3 mm wide; thalline exciple with retrorse hairs at the base ..... ***M. stygia***

Melanelia agnata (Nyl.) A. Thell, Nova Hedwigia 60(3–4): 416 (1995) Fig. 2E,F

≡ *Platysma agnatum* Nyl., Flora, Jena 60: 502 (1877)

≡ *Cetraria agnata* (Nyl.) H. Kristinsson, Lichenologist 6: 144 (1974)

Thallus foliose, corticolous or saxicolous, appressed, 1–9 cm diam.; lobes 0.5–2.5 mm wide, usually concave; upper surface glossy brownish black to greenish brown; soredia and isidia absent; lower surface pale brown, sometimes wrinkled, margin dark coloured; rhizines laminal to marginal,

simple to irregularly branched, black; pseudocyphellae conspicuous, whitish, laminal or submarginal; medulla white. Apothecia not seen. Pycnidia common, marginal to laminal emergent or somewhat immersed; pycnoconidia bifusiform, dumb-bell shaped, 4.5–7 × 1–1.5 µm.

Chemistry—Medulla K–, C–, P–, KC–; no lichen substance present in TLC.

Specimen examined—**INDIA, Arunachal Pradesh, Tawang district**, Sela Pass, alt. 4135 m, on boulders, 17.06.2015, R. Bajpai 15-026539 (LWG).

Remarks—*Melanelia agnata* closely resembles *M. hepatizon* and *M. stygia* morphologically. *Melanelia hepatizon* can be distinguished by the presence of inconspicuous pseudocyphellae, smooth lobes, and the presence of stictic and norstictic acids, while *M. stygia* differs in the presence of caperatic and fumarprotocetraric acids in the thallus.

Ecology & distribution—A single specimen was collected at 4135 m in Arunachal Pradesh. Previously known from Iceland and Russia (Thell 1995), this is the first report of *Melanelia agnata* from India.

Melanelia hepatizon (Ach.) A. Thell, Nova Hedwigia 60: 419 (1995)

≡ *Lichen hepatizon* Ach., Lichenogr. Suec. Prodr.: 110 (1798)

≡ *Cetraria hepatizon* (Ach.) Vain., Term. Füz. 22: 278 (1899)

≡ *Tuckermannopsis hepatizon* (Ach.) Kurok., J. Jap. Bot. 66: 158 (1991)

Thallus foliose, saxicolous, appressed, 1–8 cm across; lobes 0.25–1.5 mm broad, irregularly divided and branched, often concave; upper surface shiny greenish brown to dark brown or black, glossy to mat, margin and lamina with short, black pycnidial papillae; lacking isidia and soredia; lower surface dark brown-black, mat; rhizines scattered, laminal to marginal, simple to irregularly branched, black; pseudocyphellae 0.1–0.5 mm long, rounded to elongate and irregular, whitish to obscure, marginal and rarely laminal; medulla white. Apothecia marginal, ≤1–2 mm in diam.; ascospores 8–12 × 5–7.5 µm. Pycnidia frequent, marginal to laminal, immersed, sessile or slightly pronounced; pycnoconidia bifusiform, dumb-bell shaped, 4–7 × 1–1.5 µm.

Chemistry—Medulla K–, C–, P+ orange, KC–; stictic and norstictic acids present in TLC.

Specimens examined—**INDIA, Sikkim, North Sikkim district,** Yangdi, above Thangu, alt. 4250 m, on soil, 13.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-003978, 04-003884, 04-003966, 04-004010, 04-003850, 04-003918 (LWG); **North Sikkim**, Llonakha valley, near Chhaber lake, below Luna La, alt. 4600 m, on rock, G.P. Sinha 1589B, 1596 (BSHC). **Uttarakhand, Uttarkashi district**, on way to Gomukh, near Bhojwasa, alt. 4000 m, on soil, 30.6.1976, D.D. Awasthi & S.R. Singh

8379 (LWG-AWAS), Near Gangotri towards Gomukh, alt. 3150 m, on soil, 30.6.1976, D.D. Awasthi & S.R. Singh 8489/B (LWG-AWAS), after Chirwasa, alt. 3600 m, on rock, 5.9.2002, S. Chatterjee & P.K. Divakar 02-000193 (LWG).

Remarks—*Melanelia hepatizon* is distinguished by the brown-black upper side of the thallus, P+ orange medullary reaction and the crenulate margin of the apothecia. *M. hepatizon* morphologically resembles *M. stygia,* but *M. stygia* differs in having a P+ orange reaction and laminal pseudocyphellae.

Ecology & distribution—*Melanelia hepatizon* grows on exposed rocks and boulders at 4100–4600 m in dry temperate to alpine regions of Sikkim and Uttarakhand.

Melanelia stygia (L.) Essl., Mycotaxon 7(1): 47 (1978)

≡ *Lichen stygius* L., Sp. Pl. 2: 1143 (1753)

≡ *Parmelia stygia* (L.) Ach., Methodus: 203 (1803)

Thallus foliose, saxicolous, adnate to loosely attached, 8 cm across; lobes ≤3 mm wide; margin weakly crenulate; upper surface olive-brown to darker, concave to convex, dull to shining at apices; pseudocyphellae submarginal to laminal, rounded to elongate and irregular, 0.1–0.5 mm long, irregular to effigurate, whitish; isidia and soredia lacking; lower surface black; rhizines scattered, laminal to marginal, simple, black, 2–3 mm long; medulla white. Apothecia ≤10 mm in diam., ascospores 10–17 × 4.5–8 µm. Pycnidia frequent, marginal to laminal, immersed to sessile; pycnoconidia bifusiform, 4–7 × 1–1.5 µm.

Chemistry—Medulla K–, C–, P– or P+ orange, KC–; caperatic and fumarprotocetraric (±) acids present in TLC.

Specimens examined—**INDIA, Arunachal Pradesh, West Kameng district**, 7 km before Sela pass, alt. 3835 m, on bark, 12.11.2008, D.K. Upreti, U. Dubey, G.K. Mishra & R. Khare 08-009374/D (LWG); **Tawang district**, Naguia, alt. 4290 m, on rock, 25.9.2012, R. Debnath 12-017795 (LWG). **Himachal Pradesh, Kullu district**, Marchi, on way to Rohtang Pass, alt. 3301 m, on soil, 31.5.2013, R. Bajpai 13-023268 (LWG), Great Himalayan National Park, Pardi, alt. 3240 m, on rock, Nov. 2002, S. Nayaka & R. Srivastava 02-001010, 02-001256 (LWG), 7.9.1990, D.K. Upreti 99-53661 (LWG); **Kinnaur district**, in and around Puh, alt. 3000 m, on soil, 1.11.2003, D.K. Upreti & R. Srivastava 03-002612 (LWG); Recong Peo, on way from Chini to Pangi village, alt. 2900 m, on rock, 3.11.2003, D.K. Upreti, R. Srivastava & Prakash 03-002682, 03-0026660 (LWG); **Lahul Spiti district**, Darcha, alt. 3200 m, on rock, 4.8.2003, D.K. Upreti & S. Chatterjee 03-001718, 03-001733, 03-001753 (LWG); Chota Dara, alt. 3600 m, on rock, 3.8.2002, D.K. Upreti & P.K. Divakar 02-000077/A (LWG); **Shimla district**, Rohu Chanshal pass, alt. 3632 m, on bark, 24.8.2016, R. Bajpai 16-030241, 16-030248, 16-30343 (LWG). **Sikkim, South Sikkim district**, Kupup, around Bethang lake, alt. 4100

m, on rock, G.P. Sinha 1437 (BSHC), on way between Phuni-Yakche, alt. 3000 m, on rock, G.P. Sinha 1088 (BSHC), Thangu, along Teesta bank, alt. 3800 m, on rock, G.P. Sinha 1145 (BSHC), Sebu La Base Camp, west side, alt. 4500–4800 m, on rock, G.P. Sinha 1224 B (BSHC); **West Sikkim**, Dzongri, alt. 4000 m, on rock, G.P. Sinha 787, 788, 789 (BSHC), Thangsing-Samiti foot track, alt. 3700 m, on rock, G.P. Sinha 834 (BSHC). **Uttarakhand, Bageshawar district**, Dwali to Phurkia, alt. 3500 m, on rock, 10.6.1970, D.D. Awasthi 7653, 7643 (LWG-AWAS); **Chamoli district**, Between Wan to Bhuna, alt. 3300 m, on rock, 23.10.1967, A. Singh 91586 (LWG); **Rudraprayag district**, Rudraprayag temple, alt. 2200 m, on rock, 28.8.2006, D.K. Upreti, S. Chatterjee & B. Kumar 06-006209 (LWG), Kedarnath valley, around temple, alt. 3500 m, on rock, 28.8.2006, D.K. Upreti, P.K. Divakar & B. Kumar 06-006222 (LWG). **West Bengal, Darjeeling district**, way from Sandakphoo to phalut, alt. 3600 m, on bark, 16.6.1967, D.D. Awasthi & M.R. Agrawal 67.462, 67.468 (LWG-LWU).

Remarks—*Melanelia stygia* is morphologically similar to *Montanelia panniformis* (Nyl.) Divakar & al. (≡ *Melanelia panniformis* (Nyl.) Essl.), which lacks fumarprotocetraric acid in the thallus.

Ecology & distribution—*Melanelia stygia* grows on exposed rocks at 3700–4600 m and is widely distributed in the alpine regions of Arunachal Pradesh, Himachal Pradesh, Sikkim, Uttarakhand, and West Bengal.

Nephromopsis Müll. Arg., Flora 74: 374 (1891)

Thallus foliose to subfruticose, often large, irregularly lobate; lobes dichotomously to irregularly branched; margin undulating; upper surface yellowish green, grey or straw yellow or brown, smooth, rugose to reticulate; with or without isidia, soredia and pseudocyphellae; upper cortex paraplectenchymatous, with non-pored epicortex; lower surface usually dark brown to black with punctiform pseudocyphellae; rhizines simple, sparse; medulla white or pigmented. Apothecia usually submarginal, nephromoid or non-nephromoid (developing on the underside of the margin); asci 8 spored, clavate; ascospores hyaline simple, subglobose, globose or ellipsoid, subspherical, 5–7 µm in diam. Pycnidia marginal and laminal, emergent; pycnoconidia usually with two swellings, dumb-bell to disc-bar shaped (rarely without swelling, bacilliform), 5–6 × 1 µm.

Out of 58 species of *Nephromopsis* known worldwide (Randlane & al. 2013), 26 species are represented in India.

Key to the species of genus *Nephromopsis* from India

1. Thallus containing usnic acid 2
1. Thallus lacking usnic acid 23

2. Pseudocyphellae present on upper or lower surface,
± black rimmed and with black fibrils at the rim;
fumarprotocetraric acid absent (other lichen substances present) 3

2. Pseudocyphellae present on both surfaces,
black rimmed, with or without black fibrils at the rim;
fumarprotocetraric acid present 21

3. Thallus mainly terricolous; lobes elongate, usually narrow, 2–10 mm wide 4

3. Thallus corticolous and terricolous; lobes short, 8–30 mm wide 5

4. Thallus pale yellowish to yellow; lobes canaliculate to tubular,
surface smooth; lower part reddish ..... ***N. cucullata***

4. Thallus yellow to dark yellow; lobes planar,
surface foveolate and wrinkled; lower part dark yellow ..... ***N. nivalis***

5. Thallus terricolous, subfruticose, suberect; laciniate lobate 6

5. Thallus corticolous or otherwise, foliose, horizontally spreading 7

6. Lower surface brown,
pseudocyphellae white and very distinct ..... ***N. leucostigma***

6. Lower surface yellow to brown,
pseudocyphellae grey as a distinct dark line ..... ***N. melaloma***

7. Thallus sorediate or isidiate 8

7. Thallus without soredia or isidia 9

8. Thallus sorediate, soredia white, marginal ..... ***N. laureri***

8. Thallus isidiate, isidia marginal or laminal ..... ***N. togashii***

9. Medulla yellow 10

9. Medulla white 11

10. Pseudocyphellae laminal or on ridges and plug-like outgrowths;
lower surface strongly reticulate or rugose ..... ***N. isidioidea***

10. Pseudocyphellae laminal or on ridges along the thallus margin;
lower surface moderately reticulate ..... ***N. ornata***

11. Marginal cilia present 12

11. Marginal cilia absent 19

12. Upper surface greenish brown;
thallus containing alectoronic acid ..... ***N. pseudocomplicata***

12. Upper surface grey, yellowish to brown;
thallus containing other lichen substances 13

13. Thallus coriaceous, dorsiventral;
lobules marginal to submarginal, pycnoconidia citriform ..... ***N. sikkimensis***

13. Thallus membranaceous, lobules absent, pycnoconidia bifusiform ..... ***N. ahtii***

14. Apothecia small, ≤5 mm in diam., non-nephromoid, exciple 2-layered 15

14. Apothecia large, nephromoid, exciple 2- or 3-layered 25

15. Pseudocyphellae on ridges and outgrowths of the very rugose lower surface ..... ***N. yunnanensis***
15. Pseudocyphellae present on directly on the surface, lacking on ridges and outgrowths 16

16. Medulla KC+ red or C+ pink 17
16. Medulla KC- and C- 18

17. Apothecia numerous, mainly laminal to submarginal; thallus containing lichesterinic, protolichesterinic, alectoronic, and a-collatolic acids ..... ***N. pallescens***
17. Apothecia sparse, marginal; thallus containing usnic and olivetoric acids ..... ***N. rugosa***

18. Upper surface yellow, lower surface black; pseudocyphellae present, lacking plug like outgrowths; pycnidia black, emergent, marginal and laminal ..... ***N. morrisonicola***
18. Upper surface greenish yellow, lower surface brownish; pseudocyphellate on lamellae and on plug-like outgrowths ..... ***N. laii***

19. Medulla C+ red, KC+ red; anziaic acid present ..... ***N. stracheyi***
19. Medulla C-, KC-; no lichen substance present 20

20. Thallus small, numerous pycnidia on upper and lower surfaces, lower surface reticulately ridged, veined, and pseudocyphellate; ascospores globose and subglobose ..... ***N. awasthii***
20. Thallus large, lacking fibrils along margins, lower surface smooth or wrinkled with pseudocyphellae directly on the surface; ascospores oblong to ellipsoid ..... ***N. nephromoides***

21. Medulla yellow ochraceous ..... ***N. endoxanthoides***
21. Medulla white 22

22. Medulla P+ red; fumarprotocetraric, protocetraric, and traces of lichesterinic and protolichesterinic acids present ..... ***N. rhytidocarpa***
22. Medulla P+ orange; salazinic and norstictic acids present ..... ***N. hypotrachyna***

23. Pseudocyphellae present on both surfaces, upper surface shiny brown ..... ***N. weii***
23. Pseudocyphellae present or absent 24

24. Thallus sorediate and containing protolichesterinic acid ..... ***N. chlorophylla***
24. Thallus lacking soredia and chemistry otherwise 25

25. Upper surface grey to yellowish, lobe margins ciliate; thallus containing atranorin and olivetoric acids ..... ***N. ciliaris***
25. Upper surface dark brown to reddish brown, lobe margins eciliate; thallus containing caperatic acid ..... ***N. pseudoweberi***

Nephromopsis ahtii (Randlane & Saag) Randlane & Saag,
Mycol. Progr. 4(4): 311 (2005)

≡ *Tuckneraria ahtii* Randlane & Saag in Randlane & al., Acta Bot. Fenn. 150: 147 (1994)

Thallus foliose, corticolous, loosely adnate, horizontally spreading, ≤10 cm across; lobes 4–10 (–25) mm wide, rounded to elongate, convolute, margin smooth to crenate, ciliate, pycnidiate; cilia pale to brown, ≤5 mm long; pycnidia dense or sparse, black in fibrils; upper surface grey or brown to yellowish green, smooth to faintly rugose in central part; soredia and isidia absent; lower surface black, bearing conspicuous, black marginal pycnidial projections; rhizines present in central part of thallus, brown, simple, 1.5–3 mm long; pseudocyphellae present, white, pale brown to dark brown. Apothecia small, marginal, nephromoid, with oblong or reniform brown disc, 2–5 mm diam.; asci narrowly clavate 10–30 × 6–9 µm; ascospores subglobose 5–9 × 4–5 µm. Pycnidia marginal, emergent projections; pycnoconidia bifusiform 5 × 1.5 µm.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; lichesterinic and protolichesterinic acids present in medulla in TLC.

Specimens examined—**INDIA, Arunachal Pradesh, West Kameng district**, Bomdila, Sela Pass alt. 4221 m, on bark, 12.11.2008, D.K. Upreti, U. Dubey, G.K. Mishra & R. Khare 08-009395/A, 08-009424 (LWG). **Sikkim, North Sikkim**, Tholung-Kissong track, alt. 2475-2700 m, on bark, G.P. Sinha 586, 588 (BSHC), Above Lachen, alt. 3000 m, on bark, 12.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-003770/A, 04-003805, 04-003981, 04-004138/A, 04-004180, 04-003781 (LWG); **East Sikkim**, Rechala surroundings, alt. 2700-2900 m, on bark, G.P. Sinha 1002 & 1003 (BSHC), **West Sikkim**, on way between Thangsing-Phedang track, alt. 3500 m, on bark, G.P. Sinha 867 (BSHC), Yoksum-Tsoka foot track, alt. 1800-3050 m, on bark, G.P. Sinha 202A (BSHC), Yoksum, on soil, 16.5.1960, M.N. Bose, 6278 (LWG-AWAS);. **Uttarakhand, Bageshwar district**, Phurkia to Pindari Glacier, near Mirtoli, alt. 3400 m, on bark, 11.6.1970, D.D. Awasthi 7695 (LWG-AWAS). **West Bengal, Darjeeling district**, Tiger Hill, alt. 2500 m, on soil, 17.4.1960, M.N. Bose 6237 (LWG-AWAS).

Remarks—*Nephromopsis ahtii* shares a similar morphology and ascospore with *N. ornata,* which differs in having a pale yellow medulla, lacking marginal cilia, and having ellipsoid (not globose) ascospores (Randlane & al. 1995).

Ecology & distribution—*Nephromopsis ahtii* commonly grows on trees, rarely on soil in open places. It grows on variety of trees including *Pinus* and *Quercus* at 2475–4300 m and is widely distributed in both lower temperate and temperate regions of Arunachal Pradesh, Sikkim, Uttarakhand, and West Bengal.

Nephromopsis awasthii G.K. Mishra, Nayaka & Upreti, **sp. nov.** Figs 3–4

MB 840586

Similar to *Nephromopsis nephromoides* but differs in having a smaller, grey to greenish thallus, larger apothecia, numerous pycnidia on upper and lower surfaces, a reticulately ridged to veined lower surface with pseudocyphellae, and filiform pycnoconidia.

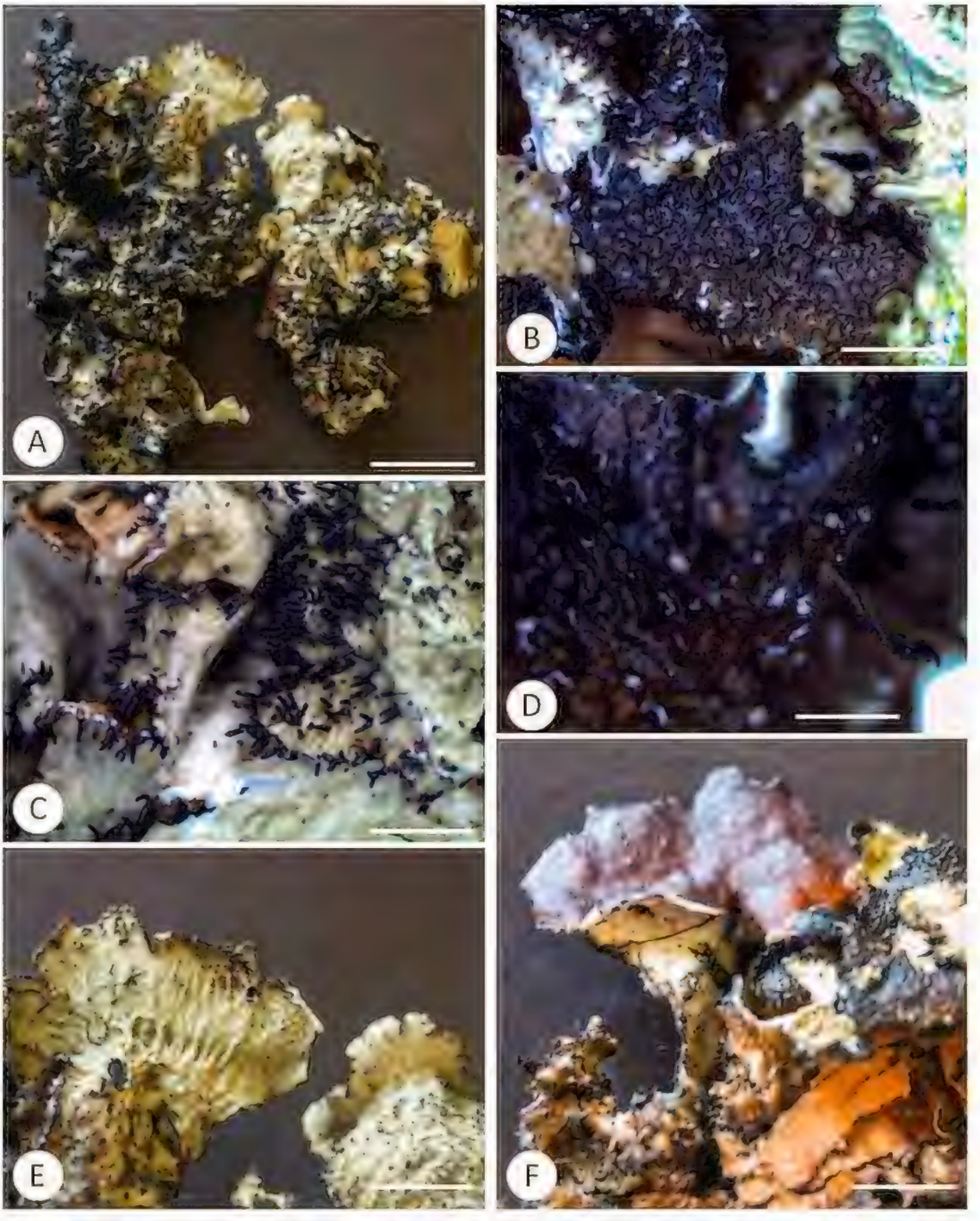

Fig. 3. ***Nephromopsis awasthii*** (holotype, LWG 18-037882a). A. habit; B. lower side of thallus with pseudocyphellae; C. marginal and laminal pycnidia; D. rhizines; E. upper side of apothecia with marginal pseudocyphellae; F. lower side of apothecia. Scale bars = 1 cm.

Type: India, Arunachal Pradesh, Tawang district, near Mungluam Gompa Monastery, near HSP-3, alt. 3656 m, on bark, 12.11.2019, R. Bajpai & R.R. Paul 19-037822 (**Holotype**, LWG 18-037882a; **isotype**, LWG 19-18-037882b).

Etymology: In honour of the distinguished Indian Lichenologist Dr. Dharani Dhar Awasthi (1922–2011).

Thallus foliose, corticolous, adnate to loosely attached to the substrate, horizontally spreading, ≤7 cm across; lobes rounded and convoluted, 0.5–1 cm wide, imbricate, black fibrils present along margins; upper surface greenish grey to yellowish grey, smooth to wrinkled, lobe margins sometimes black; isidia and soredia absent; lower surface white at center and pale brown to brownish to black towards margin, reticulately ridged and veined; pseudocyphellae present on lower surface on ridges or flat surface but not as plug like outgrowths or on the apothecial margins; rhizines sparse, long, white to brownish, simple or branched, ≤5 mm long; medulla white. Apothecia marginal on lower surface, nephromoid to semi-reniform, ≤15 mm in diam., exciple 2-layered, disc brown; hypothecium ≤90 µm long; asci clavate, 30–33 × 11–13 µm; ascospores colourless, globose to subglobose, 5–8.3 × 3.5–6.3 µm. Pycnidia numerous, on black emergent projections on marginal, laminal, and lower thallus surfaces; pycnoconidia filiform, 9–12.9 × 1–1.3 µm.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; lichesterinic and protolichesterinic acids present in medulla in TLC.

Additional Specimens examined—**INDIA, Arunachal Pradesh, Tawang district**, near Nagala Lake HSP-1, alt. 4137 m, on bark, 13.11.2019, R. Bajpai & R.R. Paul 19-036791, 19-037818 (LWG).

Remarks—The new species *Nephromopsis awasthii* is characterized by a small thallus, numerous pycnidia and reticulately ridged lower surface, veined pseudocyphellae, and filiform pycnoconidia. *N. awasthii* strongly resembles *N. nephromoides* in thallus colour and large apothecia but *N. nephromoides* differs in lacking pycnidia and presence of oblong ascospores. *Nephromopsis awasthii* also resembles *N. ahtii* in having pycnidia on emergent projections and subglobose ascospores but differs in absence of marginal cilia and having larger apothecia measuring ≤15mm in diam. *Nephromopsis yunnanensis* is morphologically similar to *N. awasthii,* which differs in the lack of plug-like outgrowths on the lower surface. *Nephromopsis awasthii* shares small flat pseudocyphellae on the ridges of the lower surface with *N. laii,* which differs in having small apothecia and lacking pycnidia. The new species is also morphologically similar to *N. hypotrachyna* and *N. rhytidocarpa*, which are characterized by broadly ellipsoid ascospores, and the presence of salazinic and norstictic acids (Awasthi 1982). The combination of a small thallus, large apothecia,

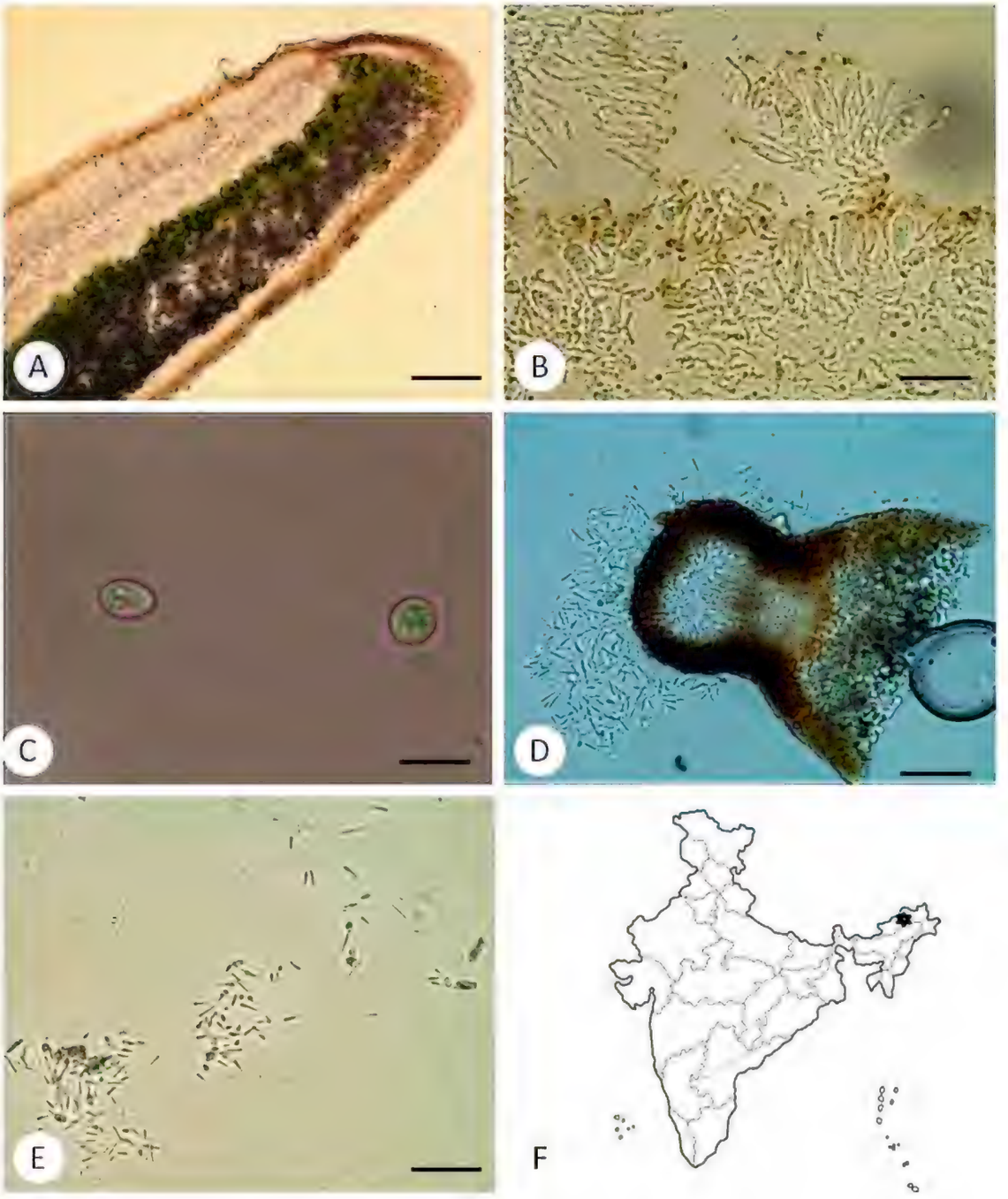

Fig. 4. ***Nephromopsis awasthii*** (holotype, LWG 18-037882a). A. section showing exciple; B. section showing asci; C. ascospores; D. pycnidia with conidia; E. pycnoconidia; F. Indian distribution. Scale bars = 1 cm.

frequent pycnidia, and filiform pycnoconidia in *Nephromopsis awasthii* is a unique set of characters of the new species.

Ecology & distribution—*Nephromopsis awasthii* grows on tree bark at 3635–4137 m and is so far known only from the surroundings of the type locality in Arunachal Pradesh, where it was growing in abundance.

Nephromopsis chlorophylla (Willd.) Divakar, A. Crespo & Lumbsch,
Fungal Diversity 84: 112 (2017)
≡ *Lichen chlorophyllus* Willd. in Humboldt, Fl. Frib. Spec.: 20 (1793)
≡ *Cetraria chlorophylla* (Willd.) Vain., Acta Soc. Fauna Fl. Fenn. 13(6): 7 (1896)
≡ *Tuckermannopsis chlorophylla* (Willd.) Hale in Egan, Bryologist 90: 164 (1987)

Thallus foliose, corticolous, loosely appressed, ≤3 cm across; lobes 2–3 mm wide, ± concave; margin ascending, undulate; upper surface yellowish brown, smooth; soredia present, soredia marginal, whitish farinose to grey granular; lower surface white to pale brown; pseudocyphellae absent; rhizines present, dark brown to blackish in the central region, remainder erhizinate and ±wrinkled; medulla white. Apothecia absent in the studied material. Pycnidia present, marginal, black; pycnoconidia bifusiform, 6 × 1 µm.

Chemistry—Medulla K–, C–, P–, KC–; protolichesterinic acid present in TLC.

Specimens examined—**INDIA, Uttarakhand, Chamoli district**, valley of flowers, alt. 3300 m, on bark, 20.9.2006, S. Rawat 06-007101 (LWG); **Uttarkashi district**, Gomukh area, right bank 6th moraine, alt. 4100 m, on bark, 5.6.1976, D.D. Awasthi & S.R. Singh 8555 (LWG-AWAS). **West Bengal**, **Darjeeling district**, Sandakhpoo, alt. 2900 m, on bark, 15.6.1967, D.D. Awasthi & M.R. Agrawal 67.381 (LWG-AWAS).

Remarks—In colour and thallus size, *Nephromopsis chlorophylla* closely resembles *N. ciliaris,* which differs in its ciliate margins, wider lobes, and presence of olivetoric acid in the medulla.

Ecology & distribution—*Nephromopsis chlorophylla* is a corticolous species occurring at 2900–4100 m in Sikkim and Uttarakhand.

Nephromopsis ciliaris (Ach.) Hue,
Nouv. Arch. Mus. Hist. Nat., Paris, 4 sér. 1: 216 (1899) Fig. 5a,b
≡ *Cetraria ciliaris* Ach., Lich. univ.: 508 (1810)
≡ *Lichen squarrosus* * *ciliaris* (Ach.) Lam., Encycl. Méth. Bot., Suppl. 3: 419 (1813)
≡ *Nephromopsis ciliaris* (Ach.) Hue, Nouv. Arch. Mus. Hist. Nat., Paris, 4 sér.1: 216 (1899)

Thallus foliose, corticolous, loosely adnate, horizontally spreading, ≤10 cm across; lobes 5–10 mm wide, rotund, margin crenate ciliate, pycnidiate; cilia black, simple, ≤7 mm long; pycnidia as densely or sparsely black fibrils; upper surface grey or yellowish to brown, smooth to wrinkled; soredia and isidia absent; lower surface white and brown below margin, rhizines present in central part of thallus, brown, simple, 1.5–3 mm long; pseudocyphellae absent; medulla white. Apothecia not seen. Pycnidia marginal, emergent projections; conidia citriform 5 × 7 µm.

Chemistry—Medulla K–, C–, KC+ reddish, P–; atranorin and olivetoric acids present in TLC.

Specimen examined—**INDIA, Karnataka, Bangalore district**, Bahhergatta Nazam-Kalu, alt. 980 m, on bark, 30.04.1979, D.D. Awasthi, D.K. Upreti & U. Mishra 79-273 (LWG-LWU).

Remarks—*Nephromopsis ciliaris,* which is similar in morphology and presence of cilia to *N. ahtii*, differs in its citriform pycnoconidia and the presence of atranorin and olivetoric acids as secondary metabolites and. *Nephromopsis chlorophylla,* which resembles *N. cilaris* in similar thallus colour and size, differs in the absence of cilia and the presence of protolichesterinic acid in thallus.

Ecology & distribution—*Nephromopsis ciliaris,* is rare in India and grows on trees at 980 m in the South Indian region in Karnataka. This species has been reported from other Asian countries, Europe, and North America (Gyelnik 1933; Brodo & al. 2001). This is the first record for India.

Nephromopsis cucullata (Bellardi) Divakar, Crespo & Lumbsch, Fungal Diversity 84: 112 (2017)

≡ *Lichen cucullatus* Bellardi, Osserv. Fenn. 1: 54 (1788)

≡ *Lobaria cucullata* (Bellardi) Hoffm., Deutschl. Fl.: 143 (1796)

≡ *Cetraria cucullata* (Bellardi) Ach., Methodus: 293 (1803)

≡ *Flavocetraria cucullata* (Bellardi) Kärnefelt & A. Thell, Acta Bot. Fenn. 150: 81 (1994)

Thallus foliose to subfruticose, terricolous, suberect to erect, ≤3 cm tall, subdichotomously branched, lobes ≤4 mm wide, canaliculate by connivent margins, upper surface yellow, basal part reddish, smooth; lacking isidia and soredia; lower surface pale yellow, smooth, minutely pseudocyphellate; marginal projections absent; rhizines present, simple; medulla white. Apothecia not seen. Pycnidia not seen.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; lichesterinic and protolichesterinic acids present in TLC.

Specimens examined—**INDIA**, **Sikkim**, **North Sikkim**, Llonakha valley, Chhaber lake below Luna La, alt. 4600 m, on soil, G.P. Sinha 1606 (BSHC). **Uttarakhand**, **Bageshwar district**, Phurkia to Pindari Glacier, alt. 11500ft, on soil, 23.5.1950, D.D. Awasthi 781A (LWG-AWAS); **Uttarkashi district**, Gomukh area, right bank, 5th moraine, alt. 12500 ft, on bark, 5.7.1976, D.D. Awasthi & S.R. Singh 8493B (LWG-AWAS).

Remarks—*Nephromopsis cucullata* is easily distinguished by an involute, canaliculate, pale yellow to yellow, thin thallus. The species is morphologically

similar to *N. nivalis,* which differs in absence of secondary metabolites and flat thallus.

Ecology & distribution—*Nephromopsis cucullata* grows in association with mosses in alpine region at 4100–4600 m in the states of Sikkim and Uttarakhand.

Nephromopsis endoxanthoides (D.D. Awasthi) Randlane & Saag, Mycotaxon 44(2): 486 (1992)

≡ *Cetraria endoxanthoides* D. D. Awasthi, Bull. Bot. Surv. India 24: 9 (1982)

≡ *Cetreliopsis endoxanthoides* (D.D. Awasthi) Randlane & Saag in Randlane, Thell & Saag, Cryptog. Bryol. Lichenol. 16(1): 51 (1995)

Thallus corticolous, 4 cm across; lobes 5–10 mm wide; upper side greenish yellow with pseudocyphellae in the central part; isidia and soredia absent; lower side brown-black, sparsely pseudocyphellate and rhizinate; medulla yellow ochraceous. Apothecia marginal, 3–5(–6) mm in diam., disc reflexed upwards; ascospores 6–9.5 × 4.5–6 µm. Pycnidia marginal or laminal; pycnoconidia 5–6 × 1.5–2 µm.

Chemistry—Medulla K+ yellow, C–, KC–, P+ orange; fumarprotocetraric, protocetraric acids; traces of protolichesterinic and lichesterinic acids and unknown pigments present in TLC.

Remarks—*Nephromopsis endoxanthoides* is morphologically similar to *N. rhytidocarpa,* which is separated by a white medulla. The type specimen was not available for the present study, and the description above is based on Jagadeesh Ram & Sinha (2010).

Ecology & distribution— The corticolous *N. endoxanthoides* grows at 2250 m in West Bengal state of the Eastern Himalaya.

Nephromopsis hypotrachyna (Müll. Arg.) D.D. Awasthi, Lichenol. Indian Subcontinent: 15 (2000)

≡ *Cetraria hypotrachyna* Müll. Arg. Flora 74: 373 (1891)

≡ *Cetreliopsis hypotrachyna* (Müll. Arg.) Randlane & Saag, Mycotaxon 87: 482 (2003)

Thallus foliose, corticolous, adnate, ≤12 cm across; lobes 10 mm wide; upper surface greenish to yellow; pseudocyphellae present on both surfaces, on the upper surface in the submarginal zone occurring as white patches and often with black pycnidial projections and on the lower surface dark brown to black with sparse tiny grayish dots located on thallus ridges, pseudocyphellate; isidia and soredia absent; rhizines present, black to brown; medulla white. Apothecia marginal, ≤6 mm in diam., with dark brown disc; asci clavate, 30–33 × 11–13 µm; ascospores broadly ellipsoid,

7–8 × 4–6 µm. Pycnidia marginal and laminal on both surfaces; pycnoconidia bifusiform, 4×1 µm.

Chemistry—Medulla K+ yellow-brown, C–, KC–, P+ orange-red; salazinic and norstictic acids present in TLC.

Specimen examined —**INDIA, Manipur**, on twigs, G. Watt 6949 (Holotype: BM).

Remarks—*Nephromopsis hypotrachyna* resembles *N. rhytidocarpa,* which differs in having a smooth thin thallus bearing pseudocyphellae on both surfaces. No Indian herbarium specimen was traceable. Therefore, the description is based on Awasthi (1982).

Ecology & distribution—This is a corticolous species known exclusively from its type locality at 3000 m in the state of Manipur.

Nephromopsis isidioidea (Räsänen) Randlane & Saag, Mycotaxon 44: 487. (1992)

≡ *Cetraria wallichiana* var. *isidioidea* Räsänen, Arch. Soc. Zool. Bot. Fenn. Vanamo 5(1): 25 (1950)

≡ *Cetraria isidioidea* (Räsänen) D.D. Awasthi, Bull. Bot. Surv. India 24: 10 (1983)

Thallus foliose, corticolous, loosely adnate, horizontally spreading ≤5.5 cm across; lobes 3–20 mm wide; upper surface yellowish grey to brownish, reticulately scrobiculate with fibrils on ridges and along margins; isidia and soredia lacking; lower surface brown to black, lamellate rugose with peg like outgrowths; pseudocyphellae present on ridges and on plug-like outgrowths; rhizines present; medulla yellow to ochraceous. Apothecia (seen only on isotype specimen) marginal, peltate to nephromoid, ≤6 mm in diam., disc dark brown, exciple thin; asci clavate 20–35 × 8–10 µm, 8-spored; ascospores colourless, simple, ellipsoid, 8–10 × 2–3 µm. Pycnidia not seen.

Chemistry—Medulla K+ yellow, C–, P–, KC–; secalonic, lichesterinic, and protolichesterinic acids present in medulla in TLC.

Specimens examined—**INDIA, Sikkim, North Sikkim**, Thangu, Chepta valley surroundings, alt. 3900 m, on bark, G.P. Sinha 1625 (BSHC). **West Bengal, Darjeeling district**, Rimbick to Sandakphoo, alt. ca 2700 m, on dead tree stump, June 1948, D.D. Awasthi 179 (LWG-AWAS).

Remarks—*Nephromopsis isidioidea* resembles *N. endocrocea* Asahina in absence of soredia and isidia and K+ yellow medulla but differs in having a strongly rugose and reticulate thallus and laminal pseudocyphellae on ridges.

Ecology & distribution—The corticolous *N. isidioidea* grows at 2700–3900 m in Sikkim and West Bengal states of the eastern Himalayas.

Nephromopsis laii (A. Thell & Randlane) Saag & A. Thell, Bryologist 100: 111 (1997)

≡ *Cetrariopsis laii* A. Thell & Randlane, Cryptog. Bryol. Lichénol. 16: 46 (1995)

Thallus foliose, corticolous, adnate, ≤12 cm across; lobes convolute, rounded, ≤10 mm wide; upper surface greenish yellow, lacking fibrils along margins; isidia and soredia lacking; lower surface brownish; pseudocyphellate on lamellae and plug-like outgrowths; rhizines short; medulla white. Apothecia marginal, round to reniform, ≤5 mm in diam., exciple two- layered; ascospores 5–9 × 2.5–4.5 µm. Pycnidia not seen.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; lichesterinic and protolichesterinic acids present in medulla in TLC.

Specimens examined—**INDIA, Arunachal Pradesh, Tawang district**, Nagala near Nagula lak, alt. 4137 m, on bark, 15.6.2015, R. Bajpai 15-026550, 15-026552 (LWG). **Andaman Islands, Middle Andaman**, Long Island, sea level, on bark, 27.3.1961, A. Singh & party 89414 (LWG). **Himachal Pradesh, Kullu district**, Great Himalayan National Park, Shilt, alt. 2800 m, on bark, 4.11.2002, S. Nayaka & R. Srivastava 02-00581/B (LWG), on way to Shilt to Gumtaro, alt. 3000 m, on bark, 6.9.1999, D.K. Upreti 99-53632 (LWG), enroute to Jalori lake, alt. 3145 m, on bark, 3.5.2008, D.K. Upreti & Y. Joshi s.n. (LWG), Pardi, alt. 3140 m, on bark, 5.11.2002, S. Nayaka & R. Srivastava 02-000519 (LWG); **Shimla district**, Rohodu Larote, enroute to Chanshal pass, alt. 3285 m, on bark, 26.8.2016, R. Bajpai 16-030301 (LWG). **Sikkim, near Karpong,** alt. 8000ft, on bark, May 1947, D.D. Awasthi 173, 174 (LWG-AWAS). **Uttarakhand, Bageshwar district**, Dhakuri ridge, alt. 8000 ft, on bark, 8.6.1970, D.D. Awasthi 7568 (LWG); **Chamoli district**, Between Madmaheshwar to Gondar, alt. 3000 m, on bark, 19.9.1975, A. Singh & M. Ranjan 107020/B, 107020/A, 106994 (LWG), Mandakini river valley, on way from Gaunikund to Rambara, alt. 2800 m, on bark, 18.9.1976, K. Dange, 76.137 (LWG-AWAS), Joshi math, Auli, ITBP, Gosu Top, near Nandadevi temple, on bark, August 2003, S.M. Singh, 03-001854 (LWG), Nanda Devi Reserve, 1 km before Belta, alt. 3200 m, on bark, 6.6.2008, S. Rawat 08-011062/A (LWG), Auli, on bark, Aug 2003, S.M. Singh 03-001854 (LWG); **Dehradun district**, Chakrata near Deoban, alt. 3000 m, on bark, 3.7.1951, D.D. Awasthi 960 (LWG-AWAS); **Pithoragarh district**, Kalamuni, alt. 26700 m, on bark, 18.6.1973, A. Singh 102677 (LWG), between Lilam to Bugdiyar, Rana Man Singh Top, alt. 2700 m, on bark, 25.6.1973, A. Singh 102772 (LWG), Nain Singh Top, alt. 2700 m, on bark, 15.9.1966, D.K. Upreti & J. Tandon L104619 (LWG), Narayan Swami Ashram, alt. 3000 m, on bark, 2.11.2009, D.K. Upreti, G.K. Mishra & R. Khare 09-013407 (LWG); **Uttarkashi district**, Govind Wildlife Sanctuary, enroute to Judatal near nursery, alt. 2312 m, on bark, 5.10.2013, R. Bajpai 13-02005/B, 13-020005, 13-020048/A (LWG), Judatal to Kedarkantha, alt. 2871 m, on bark, 6.10.2013, R. Bajpai 13-020018/E, 13-020066, 13-020016/A (LWG), Talahuti 3 km from Taluka, alt. 2155 m, on bark, 5.4.2013, R. Bajpai 13-01998, 13-019465 (LWG), 4 km before Sankari enroute to Natwar, alt. 2400 m, on bark, 7.11.2012, R. Bajpai 12-018337, 12-018864 (LWG), around Judatal, alt. 3400 m, on bark, 5.11.2012, R. Bajpai, 12-018951, 12-018976

(LWG), Judatal to Kedarkantha, alt. 3400 m, on bark, 6.10.2013, R. Bajpai 13-020116, 13-020068, 13-019875, 13-020018 (LWG), enroute to Har-ki-Dun, from Osla, alt. 3205 m, on bark, 11.6.2012, D.K. Upreti & R. Bajpai 12-016148 (LWG).

Remarks—*Nephoromopsis laii* is similar in ascospore shape and size to *N. rugosa*, which differs in its smooth or slightly rugose thallus and different chemistry.

Ecology & distribution—*Nephoromopsis laii* grows on bark at 2100–3500 m and is widely distributed in Arunachal Pradesh, Andaman Islands, Himachal Pradesh, Sikkim, and Uttarakhand.

Nephromopsis leucostigma (Lév.) A. Thell & Randlane, Mycol. Progr. 4: 311 (2005)

≡ *Cetraria leucostigma* Lév., in Jacquemont, Voy. Inde 4: 180 (1844)

≡ *Flavocetrariella leucostigma* (Lév.) D.D. Awasthi, Comp. Macrolich. India, Nepal & Sri Lanka: 162 (2007)

= *Cetraria sikkimensis* Räsänen, Arch. Soc. Zool. Bot. Fenn. Vanamo 5(1): 25 (1950) ["1951"]

Thallus fruticose, suberect to erect, corticolous or terricolous, 3–8 cm tall, irregularly to dichotomously branched; lobes widening upwards, 5–10 mm wide, plane to involute, subcanaliculate towards apices, undulating along the margins; upper surface yellow to brown to pale brown, smooth, 0.2–0.4 mm, black fibrils present at margin; isidia and soredia absent; lower surface pale brown to dark brown colour, smooth to slightly lacunose-rugose, pseudocyphellae present, white, depressed, rounded to irregular, depressed, brown rimmed present when thallus yellow, ≤0.1–0.5 mm across; rhizines present, black, in clusters; medulla white. Apothecia very rare (seen only isotype of *C. sikkimensis*), marginal, peltate to subnephromoid, round to oblong, 10 × 6 mm in size, disc brown, smooth; asci 8-spored; ascospores hyaline simple, ovoid, 8–9 × 6 µm. Pycnidia not seen.

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; lichesterinic and protolichesterinic acid present in medulla in TLC.

Specimens examined—**INDIA, Himachal Pradesh, Kullu district**, Great Himalayan National Park, Soupdhar, alt. 3900 m, on bark, 7.09.1999, D.K. Upreti 99-53676 (LWG); **Shimla district**, Shimla, on soil, October 1978, A. Singh L18205 (LWG). **Uttarakhand, Bageshwar district**, Mirtoli plain near Pindari, alt. 3750 m, on soil, 27.5.1972, A. Singh 91986 (LWG), on way to Phurkia to Mirtoli, alt. 2900 m, on bark, D.D. Awasthi 7744 (LWG-AWAS); **Uttarkashi district**, Gomukh area right bank, 5th Moraine, alt. 4200 m, on soil, 4.6.1976, D.D. Awasthi & S.R. Singh 8493A, 8473 (LWG-AWAS).

Remarks—*Nephromopsis leucostigma* is morphologically close to *N. melaloma,* which differs in its yellowish to grey (not brown) thallus and indistinct pseudocyphellae.

Ecology & distribution—*Nephromopsis leucostigma* is terricolous and occurs at 2500–4200 m in the Western Himalayan states Himachal Pradesh and Uttarakhand.

Nephromopsis laureri (Kremp.) Kurok., J. Jap. Bot. 66: 156 (1991)

≡ *Cetraria laureri* Kremp., Flora 34: 673 (1851)

≡ *Tuckneraria laureri* (Kremp.) Randlane & A. Thell, Acta Bot. Fenn. 150: 149 (1994)

Thallus foliose, corticolous, ≤5 cm across; lobes 2–5 mm wide, imbricate, margin rounded to weakly crenate, with minute black fibrils; upper surface yellowish to grey, involute, smooth to scrobiculate; soredia present, soredia marginal, discontinuous, farinose to granular, intermittently present between minute fibrils, isidia absent; lower surface pale brown or concolorous with upper surface, slightly rugose; pseudocyphellae present, white; rhizines sparse, concolorous with upper surface, ≤1.0 mm long; medulla white. Apothecia not seen. Pycnidia not seen

Chemistry—Medulla K–, C–, P–, KC–; usnic acid in cortex; lichesterinic and protolichesterinic acids present in TLC.

Specimens examined—**INDIA, Arunachal Pradesh, West Kameng district**, Sela Pas, alt. 4221 m, on bark, 12.11.2008, D.K. Upreti, U. Dubey & G.K. Mishra 08-009413 (LWG). **Himachal Pradesh**, G.H.N.P., Jubkutar Thach, alt. 2900 m, on bark, 10.6.1999, D.K. Upreti L65184 (LWG). **Sikkim, North Sikkim**, Shingba Rhododendron Sanctuary, alt. 3350 m, on bark, G.P. Sinha 1067 (BSHC), 2 km before Shingba Rhododendron Sanctuary, near Yumthang, alt. 3500 m, on bark, 15.08.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004113, 04-004138/B, 04-004129 (LWG), Tholung, Gumpa surrounding forest, alt. 2500 m, on bark, G.P. Sinha 623 (BSHC); **West Sikkim**, Near Bakhim, alt. 2500–2700 m, on bark, G.P. Sinha 706 (BSHC), Phedang-Dzongri foot track, alt. 3900–4025 m, on rock, G.P. Sinha 238A (BSHC), Thangsing Lampokhari foot track, 3 km point, alt. 3500 m, rock, G.P. Sinha 851 (BSHC), near Yumthang, alt. 3800 m, on bark, 15.08.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004180, 04-003967 (LWG), Kalep before Thangu, alt. 3900 m, on bark, 12.08.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-003836/A (LWG), 4 km after Lachung towards Yumthang, alt. 3100 m, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004051 (LWG), Chubuk above Thangu, alt. 4100 m, on bark, 13.08.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-003928 (LWG). **Uttarakhand, Bageshwar district**, near Dhakuri ridge, alt. 2800 m, on *Rhododendron* bark, 08.06.1970, D.D. Awasthi 7569 (LWG-AWAS); 23.05.1972, A. Singh L89335 (LWG).

Remarks—In the presence of white pseudocyphellae and colour of the upper surface, *N. laureri* closely resembles *N. togashii*, which differs in having isidia and lacking sorediate margins.

Ecology & distribution—*Nephromopsis laureri* is terricolous and occurs at 2500–4100 m in Arunachal Pradesh, Himachal Pradesh, Sikkim, and Uttarakhand.

Nephromopsis melaloma (Nyl.) A. Thell & Randlane,
Mycol. Progr. 4:311 (2005)
≡ *Platysma melalomum* Nyl., Syn. Meth. Lich. 1: 303 (1860)
≡ *Cetraria melaloma* (Nyl.) Kremp., Verh. K. K. Zool. Bot. Ges. Wien.18: 315 (1868)
≡ *Flavocetrariella melaloma* (Nyl.) D.D. Awasthi, Comp. Macrolich. India, Nepal & Sri Lanka: 163 (2007)

Thallus fruticose, suberect to erect, corticolous or terricolous, 2–3.5 cm tall, irregularly to dichotomously branched; lobes 2–5 mm wide, plane to involute subcanaliculate on upper side, margin undulate; upper surface yellow to yellowish grey to mottled brown, 0.1–0.2 mm long black fibrils at the margin; isidia and soredia absent; lower surface pale, pseudocyphellae round, brown rimmed, ≤0.5 mm acros. Apothecia not seen. Pycnidia not seen.

Chemistry—Medulla K–, C–, KC–, P–; usnic acid in cortex; lichesterinic and protolichesterinic acids and rarely stictic acid present in medulla in TLC.

Specimens examined—**INDIA, Sikkim, North Sikkim,** Lachung, on rock over soil, 27.4.1975, V.S. Sharma & M. Ranjan 76760 (LWG). **Uttarakhand, Bageshwar district**, Phurkia to Pindari Glacier near Mirtoli, alt. 3400 m, on soil, 11.6.1970, D.D. Awasthi 7695, 7775 (LWG-AWAS).

Remarks—*Nephromopsis melaloma* resembles *N. komarovii* (Elenkin) J.C. Wei, which is a saxicolous species.

Ecology & distribution—The species grows on soil in moist places in the subalpine zone at 3500 m in Sikkim and Uttarakhand.

Nephromopsis morrisonicola M.J. Lai,
Quarterly Journal of the Taiwan Museum 33(3 & 4): 223 (1980) Fig. 5c,d

Thallus foliose, corticolous, loosely adnate, ≤15 cm in diam.; lobes ascending, 8–15 mm wide; upper surface yellow, smooth; soredia and isidia absent; lower surface black, margin of lobes brown; pseudocyphellae present; rhizines present, brownish to black, simple or branched, sparsely scattered; medulla white. Apothecia not seen. Pycnidia present, marginal and laminal, emergent projections; pycnoconidia bifusiform 5.5 × 2.5 µm.

Chemistry—Medulla K–, C–, KC–, P–; usnic acid in cortex; lichesterinic and protolichesterinic acids are present in TLC.

Specimens examined—**INDIA, Arunachal Pradesh, Tawang district**, Ptso-lake, alt. 3982 m, on bark, 15.06.2015, R. Bajpai 15-026516 (LWG), Sela Pass, alt. 4135, on bark, 17.06.2015, R. Bajpai 15- 026516/A, 15-037824 (LWG). **Sikkim, South Sikkim district**, Kupup Gnathang (HSP-3), alt. 3700 m, on bark, 24 April 2014, R. Bajpai 14-024953 (LWG).

Remarks—In its black lower surface, *N. morrisonicola* closely resembles *N. ornata,* which differs in having a yellow medulla and fumarprotocetraric and secalonic acids.

Ecology & distribution—*Nephromopsis morrisonicola* is corticolous, occurring at 3702–4135 m in Arunachal Pradesh and Sikkim. This species has wide distribution, previously known from China, Indonesia, Nepal, Philippines, Papua New Guinea, and Taiwan (Randlane & Saag 1998). This is the first report from India.

Nephromopsis nephromoides (Nyl.) Ahti & Randlane,
Cryptog. Bryol. Lichénol. 19(2-3): 183 (1998)
≡ *Platysma nephromoides* Nyl., Flora 52: 442 (1869)
≡ *Cetraria nephromoides* (Nyl.) D.D. Awasthi, Bull. Bot. Surv. India 24 (1-4): 11 (1983)

Thallus foliose, corticolous, adnate to loosely attached at the central part of the thallus, horizontally spreading, ≤20 cm across; lobes rounded and convoluted ≤2–4 cm wide, imbricate, lacking fibrils along margins; upper surface greenish grey to yellowish grey, reticulate rugose, lacunose; isidia and soredia absent; lower surface pale yellow to brownish, reticulate rugose, lamellate; pseudocyphellae present on surface or on lamellate ridges but not as a plug-like outgrowths; rhizines sparse, short, brownish, simple ≤2 mm long; medulla white. Apothecia marginal on lower side, nephromoid, ≤10 mm in diam., exciple two layered, disc brown; ascospores colourless, oblong to ellipsoid 7–9 × 3.5 µm. Pycnidia not seen.

Chemistry—Medulla K–, C–, KC–, P–; usnic acid in cortex; lichesterinic and protolichesterinic acids present in the medulla in TLC.

Specimens examined—**INDIA, Arunachal Pradesh, West Kameng district**, Barts, alt. 2727 m, on bark, 22.9.2012, R. Debnath 12-017794 (LWG). **Sikkim, Mangan district**, above Lachen, alt. 3000 m, on bark, 12.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004127 (LWG). **Uttarakhand, Bageshwar district**, Dhakuri, alt. 3000 m, on bark, 22.5.1972, A. Singh 89323, 89338 (LWG), Dhakuri ridge, alt. 3000 m, on bark, 19.5.1950, D.D. Awasthi & A.M. Awasthi 642B (LWG-AWAS), Loharghet to Dhakuri, alt. 2800 m, on bark, 18.5.1950, D.D. Awasthi & A.M. Awasthi 624 (LWG-AWAS); **Chamoli district**, Auli, alt. 3000 m, on bark, 14.3.2005,

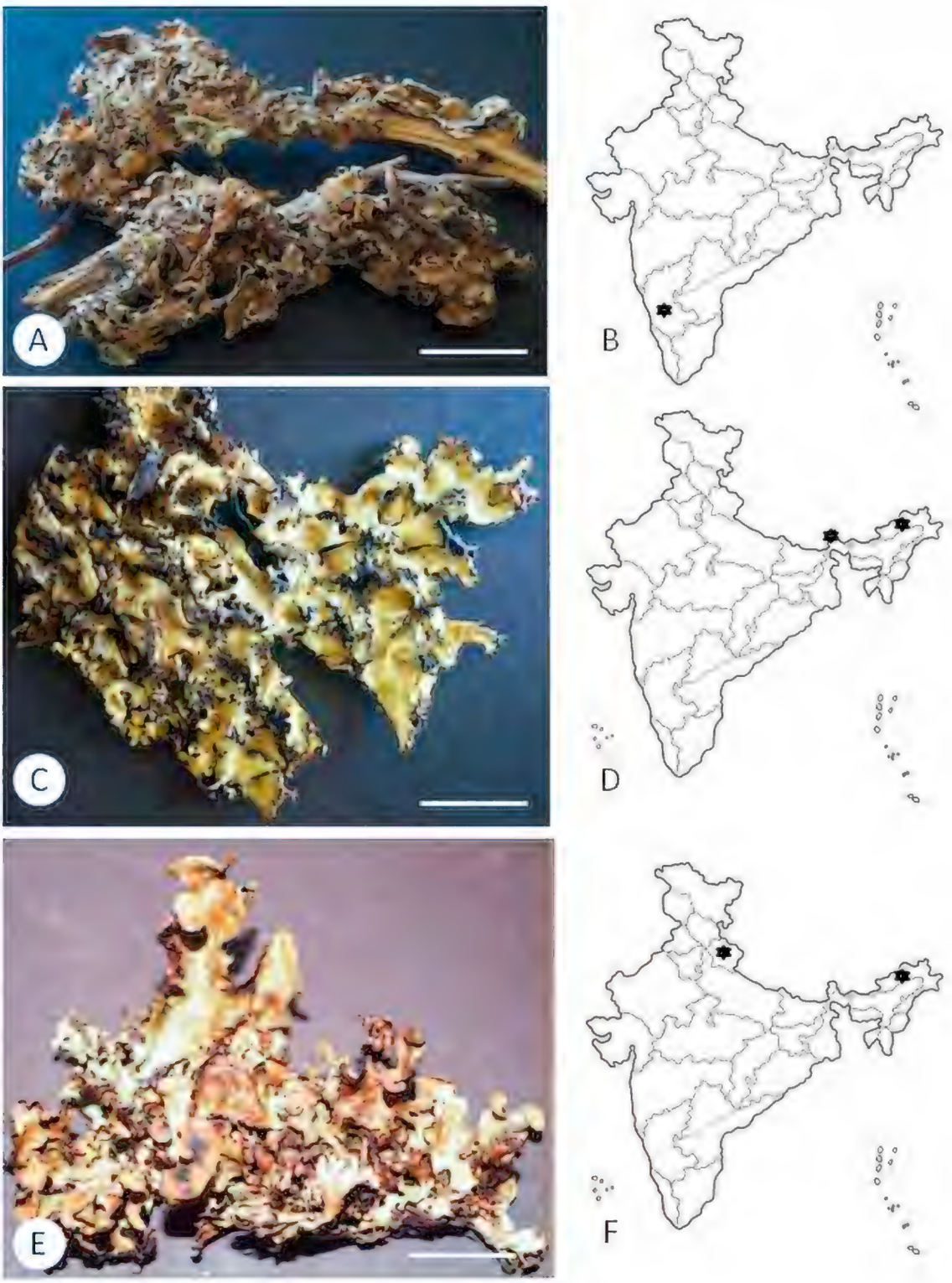

Fig. 5. ***Nephromopsis ciliaris*** (LWG-LWU 79-273). A. habit; B. Indian distribution. ***Nephromopsis morrisonicola*** (LWG 15-026516.) C. habit; D. Indian distribution. ***Nephromopsis pseudocomplicata*** (LWG 19-037823.) E. habit; F. Indian distribution. Scale bars: A, C, E = 1 cm.

M. Rao 05-005007, 05-005002 (LWG), 6.9.1991, D.K. Upreti 202327 (LWG), Nanda Devi Biosphere Reserve, 1 km before Belta, on bark, 6.6.2008, S. Rawat 08-011062/B (LWG); **Pithoragarh district**, Munsiyari, on way to Khaliya top, alt. 2900 m, on bark, 29.6.1993, D.K. Upreti 212923 (LWG), 17.11.2006, Y. Joshi & R. Bajpai 06-007075, 06-006906 (LWG), Kalamuni, alt 2670 m, on bark, 18.6.1973, A. Singh 102673 (LWG), Birthi falls, on rock, 29.10.2009, D.K. Upreti & G.K. Mishra 09-012440 (LWG). **West Bengal, Darjeeling district**, Batasi to Pahnajua, alt. 3000 m, on bark, 3.5.1960, M.N. Bose 60.65 (LWG-AWAS), on way from Sandakhpoo to Phalut, alt. 4000 m, on bark, 16.6.1967, D.D. Awasthi & M.R. Agrawal 67.442 (LWG-AWAS), 6.6.1960, M.N. Bose 60.151 (LWG-AWAS), Rinsluck to Sandakhpoo, alt. 3000 m, on bark, June 1948, D.D. Awasthi 188 (LWG-AWAS).

Remarks—*Nephromopsis nephromoides,* which shares a general thallus morphology with *N. laii,* differs in having a smooth to slightly wrinkled, medium to large thallus and flat to concave pseudocyphellae.

Ecology & distribution—*Nephromopsis nephromoides* is corticolous and is widely distributed at 2700–4000 m in Arunachal Pradesh, Uttarakhand, and the Darjeeling district of West Bengal.

Nephromopsis nivalis (L.) Divakar, A. Crespo & Lumbsch,
Fungal Diversity 84: 113 (2017)
≡ *Lichen nivalis* L., Sp. pl. 2: 1145 (1753)
≡ *Flavocetraria nivalis* (L.) Kärnefelt & A. Thell, Acta Bot. Fenn. 150: 84 (1994)

Thallus fruticose, terricolous, flat to erect, ≤5 cm across; lobes ≤7 mm wide; upper surface yellow to dark yellow, lacking marginal papillae; isidia and soredia absent; lower side foveolate, with minute pseudocyphellae; medulla white. Apothecia not seen. Pycnidia not seen.

Chemistry—Medulla K– C–, KC–, P–; no lichen substance present in TLC.

Specimens examined—**INDIA, Uttarakhand, Chamoli district**, on way from Mana to Vasudhara Falls, alt. 3340 m, on soil, 21.8.2007, D.K. Upreti & S. Nayaka 07-01032 (LWG), Nanda Devi Biosphere Reserve, N.W. Part, on soil, April-May 1993, H.R. Negi 1993 (LWG); **Uttarkashi district**, Gomukh area, right bank, 5th moraine, alt. 12500 ft, on bark, 5.7.1976, D.D. Awasthi & S.R. Singh 8473 (LWG-AWAS).

Remarks—*Nephromopsis nivalis* is unique in the genus in having a yellow thallus and strongly wrinkled lobes. It shares a yellow-coloured upper surface with *Cetraria ambigua,* which differs in having a flat upper surface and lacking foveolate lobes.

Ecology & distribution—*Nephromopsis nivalis* is terricolous, growing on soil over rock at 3300–4200 m. In India the species has a restricted distribution in Uttarakhand.

Nephromopsis ornata (Müll. Arg.) Hue,

Nouv. Arch. Mus. Hist. Nat., ser. 4, 2: 90 (1900)

≡ *Cetraria ornata* Müll. Arg., Nouvo Giorn. Bot. Ital. 23: 122 (1891)

= *Nephromopsis delavayi* Hue, Nouv. Arch. Mus. Hist. Nat., sér 4, 1: 219 (1899)

≡ *Cetraria delavayi* (Hue) M. Satô, Nov. Fl. Japon. 1: 48 (1939)

Thallus foliose, corticolous, loosely adnate, ≤16 cm in diam.; lobes ascending, 10–15 mm wide; upper surface grey to yellowish, smooth or slightly wrinkled; soredia and isidia absent; lower surface brown to black, reticulated; pseudocyphellae present, white on ridges or at marginal part; rhizines present, brownish to black, simple, sparsely scattered; medulla pale yellow. Apothecia rounded or reniform, disc brown, 20 mm diam.; asci narrowly clavate 15–35 × 6–10 µm, ascospores oblong 7–8 × 4–5 µm. Pycnidia present, marginal and laminal on emergent projections; pycnoconidia bifusiform 5 × 1.5 µm.

Chemistry—Medulla K+ deep yellow, C–, KC–, P–; usnic present in cortex; fumarprotocetraric and secalonic acids present in medulla in TLC.

Specimens examined—**INDIA, Himachal Pradesh, Kullu district,** G.H.N.P., Jubkutar Thach, alt. 2900 m, on bark, 10.6.1999, D.K. Upreti L65173 (LWG). **Sikkim, South Sikkim,** between Thangsing & Pradong, alt. 3500 m, on bark, 17.09.1995, G.P. Sinha 867 (LWG), Lachung, 27.4.1975, V.S. Sharma & M. Ranjan 76771 (LWG). **Uttarakhand, Pithoragarh district**, Munsiyari Nain Singh Top, alt. 2700 m, on bark, 15.9.1996, Upreti & Tandon L104805 (LWG). **West Bengal, Darjeeling district**, Batasi to Palujua, alt. 2500 m, on soil, June 1948, D.D. Awasthi 175 (LWG-AWAS).

Remarks—*Nephromopsis ornata* is morphologically close to *N. endocrocea,* which has a different chemistry and a white (not pale yellow) medulla.

Ecology & distribution—The species is corticolous and occurs at 2500–3500 m in Himachal Pradesh, Sikkim, Uttarakhand, and West Bengal.

Nephromopsis pallescens (Schaer.) Y.S. Park, Bryologist 93: 122 (1990)

≡ *Cetraria pallescens* Schaer. in Moritzi, Syst. Verz.: 129 (1845)

= *Sticta wallichiana* Taylor, London J. Bot. 6: 177 (1847)

≡ *Cetraria wallichiana* (Taylor) Müll. Arg., Flora 71: 139 (1888)

Thallus foliose, corticolous, loosely attached by central lower part, 8–16 cm across; lobes rounded, 2–10 mm wide, imbricate, margin smooth to dissected, undulate, convoluted, lacking black fibrils; upper surface greenish yellow to grey, scrobiculate-rugose; isidia and soredia absent; lower surface pale to brownish, scrobiculate to lamellate; pseudocyphellae on lamellae and plug-like outgrowths; rhizines sparse, brownish, 0.5–2 mm long; medulla white. Apothecia numerous, marginal or laminal to submarginal, dense, 0.5–3 mm in diam.; margin sometimes excluded, smooth to crenulate; ascospores 5–10 × 2–5 µm. Pycnidia not seen.

Chemistry—Medulla K–, C–, KC+ red, P–; usnic acid in cortex; lichesterinic, protolichesterinic, alectoronic, and alpha-collatolic acids present in TLC.

Specimens examined—**INDIA, Andaman Island**, Middle Andaman Long Island, sea level, on bark, A. Singh 89407 (LWG). **Himachal Pradesh, Kullu district**, Great Himalayan National Park, Shilt, alt. 2800 m, on bark, 4.11.2002, S. Nayaka & R. Srivastava 02-000581/A (LWG), on way to from Shilt to Gumtaro, alt. 3600 m, on bark, 6.9.1999, D.K. Upreti 99-53643, 99-54058/A (LWG), on way to Dhela to Lapah, alt. 3000 m, on bark, 8.9.1999, D.K. Upreti 99-54052, 99-54016, 99-54017 (LWG), Ecodevelopment zone Khanti, alt. 2800 m, on bark, 21.6.2004, R. Srivastava 04-003145 (LWG); **Shimla district**, Narkanda, Hatu peak, alt. 3360 m, on bark, 14.5.2002, S. Nayaka & R. Srivastava 02-81560, 02-81598 (LWG). **Sikkim, North Sikkim**, Jouri, alt. 4300 m, on bark, 23.5.1960, M.N. Bose 60.131, 63.130 (LWG-AWAS), Lachung, on bark, 27.4.1975, V.S. Sharma & M. Ranjan 76769, 76781 (LWG), Phingar, between Lachen and Thangu, alt. 3500 m, on bark, 14.7.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004033 (LWG). **Uttarakhand, Bageshwar district**, Dhakuri to Khati, alt. 2833 m, on bark, 9.6.1970, D.D. Awasthi 7619 (LWG-AWAS), 22.5.1997, D.K. Upreti, S. Chatterjee & J. Tendon L69017, L68952, L69040, L68959 (LWG), Khati to Dwali, alt. 2550 m, on bark, 24.5.1972, A. Singh 89381/A, 89316, 89381/B, 89310 (LWG), 25.9.1980, P.C. Pande 80-54315, 80-54320 (LWG), Dhakuri to Pindari, alt. 2540 m, on bark, 23.5.1972, A. Singh 89355, 89341 (LWG), on way to Sunderdhunga Glacier, between Loharkhet to Dhakur, 5 km before Dhakuri, alt. 3000 m, on bark, 11.9.1995, D.K. Upreti & Tandon 213374 (LWG), Dhakuri ridge (on way to Pindari), alt. 3300 m, on bark, 19.5.1950, D.D. Awasthi & A.M. Awasthi 640 (LWG-AWAS), 8.6.1970, D.D. Awasthi 7570, 7592 (LWG-AWAS), From Dwali to Phurkia, alt. 3210 m, on bark, 13.5.2007, S. Joshi & Y. Joshi 07-0010072 (LWG); **Chamoli district**, Badrinath between Vasundhara & Bhagirathi Glacier, alt. 3900-4500 m, on soil, 9.9.1991, D.K. Upreti s.n. (LWG), between Wan to Bhuna, on bark, 23.10.1967, A. Singh 91134, 91571, 90378 (LWG), Joshi Math to Auli, on bark, Aug 2003, S.M. Singh 03-001853 (LWG), Auli Bugyal to Wan, alt. 2850 m, on bark, 26.10.1967, A. Singh 91101 (LWG), Madmaheshwar & Gondar, alt. 3000 m, on bark, 19.9.1975, A. Singh & M. Ranjan 107009/A, 106938, 107047,106941 (LWG); **Dehradun district**, Chakrata Hills, Deoban, near Dak Banglow, alt. 3066 m, on bark, 22.6.1976, D.D. Awasthi & M. Joshi 76.83 (LWG-LWU), 3.7.1951, D.D. Awasthi 961 (LWG-AWAS), 30.10.1980, S. Chandra, s.n. (LWG); **Pithoragarh district**, Munsiyari, Kalamuni, alt. 3000-3200 m, on bark, 24.5.1988, B.S. Kholia 18476 (LWG), 18.6.1973, A. Singh 102682, 102676, 102681 (LWG), Khuliya Top, alt. 3000 m, on bark, 31.10.2009, D.K. Upreti & G.K. Mishra 09-013494 (LWG), Dharchula Sobhala forest above Kartu village, alt. 3150 m, on bark, 27.9.1990, D.K. Upreti & G. Hariharan 202217 (LWG); **Rudraprayag district**, Chopta, alt. 2700 m, on bark, 17.4.2006, D.K. Upreti & Balwant Kumar 06-005972 (LWG); **Uttarkashi district**, between Phool Chetti-Narad Chetti A. Singh & Rampher 77508, 76100/A (LWG). **West Bengal, Darjeeling district**, Batasi to Paluanjua, alt. 2400 m, on bark, 3.5.1960, M. N. Bose 60.62, 60.63 (LWG-AWAS), June 1949, D.D. Awasthi 180 (LWG-AWAS).

Remarks—*Nephromopsis pallescens* var. *pallescens* shares a closely similar thallus morphology with *N. pallescens* var. *citrina* (Taylor) A. Thell & Randlane, which differs from the typical variety in having a light to dark yellow thallus and small white dots of pseudocyphellae and lacking small numerous laminal apothecia.

Ecology & distribution—The typical variety grows abundantly on bark of different trees in open forest at 2400–4500 m. *Nephromopsis pallescens,* which is one of most common *Nephromopsis* species in India, occurs in Andaman Island, Himachal Pradesh, Sikkim, Uttarakhand, and West Bengal.

Nephromopsis pseudocomplicata (Asahina) M.J. Lai,
Quarterly Journal of the Taiwan Museum 33(3 & 4): 224 (1980) Fig. 5e,f
≡ *Cetraria pseudocomplicata* Asahina, J. Jap. Bot. 12: 804 (1936)
≡ *Tuckneraria pseudocomplicata* (Asahina) Randlane & Saag, in Randlane, Saag, A. Thell & Kärnefelt, Acta Bot. Fenn. 150: 150 (1994)

Thallus foliose, corticolous, loosely attached, 1–12 cm in diameter; lobes rounded ≤7 mm wide, ciliate; cilia scattered; upper surface greenish brown; soredia and isidia absent; lower surface white to pale brown; rhizines laminal to marginal, simple, black, ≤4 mm long; pseudocyphellae on lower side, numerous, rounded to irregular, small, whitish to pale brown, laminal or submarginal; medulla white. Apothecia marginal, rounded to reniform, 3–7 mm in diameter, reddish or brownish disc; asci clavate, 30–35 × 12–14 µm, ascospores hyaline subglobose 5–7 × 4–6 µm. Pycnidia common, marginal to laminal emergent; pycnoconidia bifusiform, 3.5–5 × 1–1.5 µm.

Chemistry—Medulla K–, C–, KC+ red, P–; usnic acid in cortex; alectoronic, lichesterinic, and protolichesterinic acids are present in TLC.

Specimens examined—**INDIA, Arunachal Pradesh, Tawang district**, Ptso-lake, alt. 3982 m, on bark, 15 June 2015, R. Bajpai 15-026520 (LWG), Sela Pass, alt. 4135 m, on bark, 17 June 2015, R. Bajpai 15-026526 (LWG), Near Mungulam Gompa Monestry, near HSP-3, alt. 3656 m, on bark, 12.11.2019, R. Bajpai & R.R. Paul 19-037823 (LWG).

Remarks—*Nephromopsis pseudocomplicata* closely resembles *N. laii* and *N. rugosa* in having similar secondary metabolites but the latter two species differ in having smooth upper surfaces, wider lobes, and oblong ascospores. Morphologically, *N. pseudocomplicata* is similar to *N. rugosa,* which is distinguished by having olivetoric acid in thallus.

Ecology & distribution—The species is corticolous, occurring at 3982–4135 m in Arunachal Pradesh. Previously *N. pseudocomplicata* was known from Japan, Sakhalin Island, and Taiwan (Randlane & al. 1994). This is the first record for India.

Nephromopsis pseudoweberi (Essl.) Divakar, A. Crespo & Lumbsch, Fungal Diversity 84: 113 (2017) FIG. 6A,B

≡ *Tuckermanella pseudoweberi* Essl., Mycotaxon 85: 139 (2003)

THALLUS foliose, corticolous, loosely adnate, 5–8 cm in diam., usually more or less orbicular; lobes 0.5–1.7 mm wide, rounded to elongate, flat to weakly concave; upper surface dark brown to brown or reddish brown, dull to slightly shiny, linear pseudocyphellate; soredia and isidia absent; lower surface brown to dark brown, mostly smooth to weakly
rugose, dull; rhizines present always in the central thallus and sometimes at the margin, sparse, simple, concolorous; medulla white. APOTHECIA ≤4 mm diam., margin crenate to papillate, bearing pseudocyphellae on the crenae or papillae; ascospores hyaline simple, subglobose to ellipsoid, 7–9 × 4–6 µm. PYCNIDIA black, immersed to weakly emergent, mostly laminal or submarginal; pycnoconidia bifusiform 4–6 µm.

CHEMISTRY—Medulla K–, C–, KC–, P–; caperatic acid is present in TLC.

SPECIMENS EXAMINED—**INDIA, ARUNACHAL PRADESH, Tawang district**, Sela Pass, alt. 4135 m, on bark, 17 June 2015, R. Bajpai 15-026511 (LWG). **SIKKIM, South Sikkim district**, Kupup Gnathang (HSP-1), alt. 3703 m, on bark, 23 April 2014, R. Bajpai 14-024922 (LWG); **North Sikkim district**, Ganthang (HSP-2), alt. 3862 m, on bark, 28 April 2014, R. Bajpai 14-024922/B (LWG).

REMARKS—*Nephromopsis pseudoweberi* is morphologically similar to *N. weberi* (Essl.) Divakar & al., which is distinguished by having olivetoric or physodic acids; *N. pseudoweberi* similar in morphology to *N. arizonica* (Essl.) Divakar & al., which differs in having 2-3 lichesterinic acid.

ECOLOGY & DISTRIBUTION—*Nephromopsis pseudoweberi* is common on tree twigs at 3703–4135 m in Arunachal Pradesh and Sikkim. Earlier this species was reported from Mexico (Esslinger 2003). This is the the first record for India.

Nephromopsis rhytidocarpa (Mont. & Bosch) Zahlbr., Annals Cryptog. Exot.1(2): 208 (1928)

≡ *Cetraria rhytidocarpa* Mont. & Bosch in Jungh., Pl. Jungh. 4: 430 (1856)

≡ *Cetreliopsis rhytidocarpa* (Mont. & Bosch.) Randlane & Saag, in Randlane, Thell & Saag, Mem. Natn Sci. Mus, Tokyo 13: 218 (1980)

THALLUS foliose to subfruticose, corticolous, loosely attached, 12 cm across; lobes 10–15 mm wide, irregularly undulate, imbricate; upper surface yellowish grey to grey black blotched along the marginal area; laminal pseudocyphellae with or without fibrils along rim; isidia and soredia absent; lower surface brown to black with pseudocyphellae, rhizines dispersed in groups, black, usually simple, sometimes furcated, ≤1 mm long; medulla white. APOTHECIA marginal,

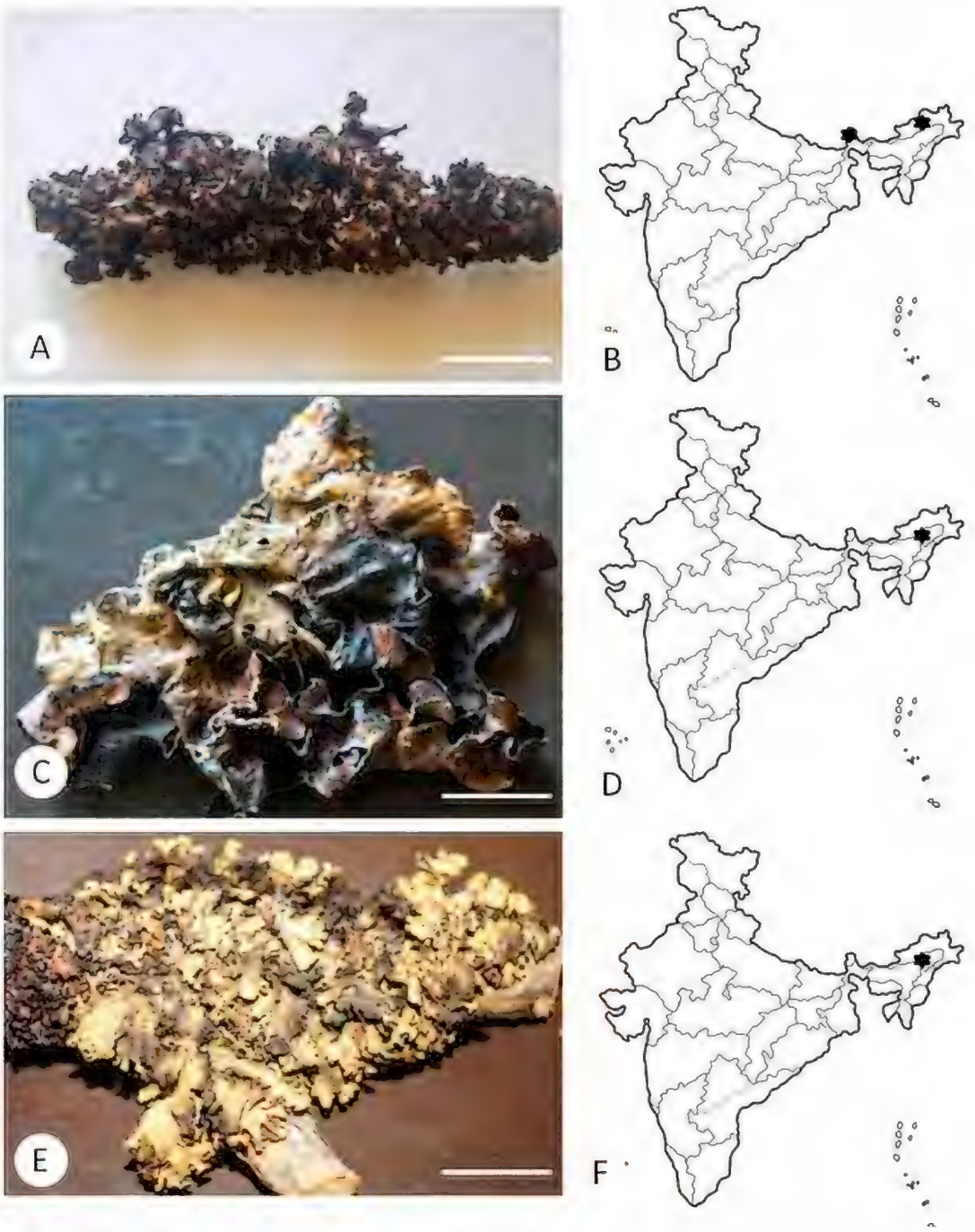

Fig. 6. ***Nephromopsis pseudoweberi*** (LWG 14-024922.) A. habit; B. Indian distribution. ***Nephromopsis rugosa*** (LWG 19-037819). C. habit; D. Indian distribution. ***Nephromopsis yunnanensis*** (LWG 15-026566). E. habit; F. Indian distribution. Scale bars: A, C, E = 1 cm.

rounded, ≤10 mm in diam., peltate to slightly nephromoid; ascospores 5–11 × 4–7 µm. Pycnidia not seen.

Chemistry—Medulla K+ yellow to red, C–, KC–, P+ orange; fumarprotocetraric and protocetraric acids; traces of lichesterinic and protolichesterinic acids present in TLC.

Specimens examined—**INDIA, Andaman Islands**, Middle Andaman Long Island, on bark, 27.3.1961, A. Singh & Party 89408, 89415 (LWG), North East, NEFA; Parila, alt. 3000 m, on bark, 2.4.1957, G. Pauigrohi 6397C (LWG), Kalaktang to Norsing, on dead wood, 15.5.1958, G. Ranigrahi 15707 (LWG-AWAS). **Sikkim**, **East Sikkim**, Rechala surroundings, alt. 2700-2900 m, on bark, G.P. Sinha 1003 B (BSHC); **West Sikkim**, Near Bakhim, alt. 2500-2700 m, on bark, G.P. Sinha 707 (BSHC). **Uttarakhand, Bageshwar district**, enroute to Pindari Glacier from Loharghet to Dhakuri, on bark, 10.5.2007, S. Joshi & Y. Joshi 07-010080 (LWG), Dhakuri, alt. 2580 m, on bark, 23.5.1972, A. Singh 89347, 89340, 89339/B, 89339/A (LWG), 22.5.1972, A. Singh 89326 (LWG), Khati to Dwali, alt. 2210-2734 m, on bark, 12.5.2007, S. Joshi & Y. Joshi 07-010076 (LWG); **Pithoragarh district**, Kalamuni, alt. 2670 m, on bark, 18.6.1973, A. Singh 102679 (LWG), Munsiyari, Nain Singh Top, alt. 2700 m, on bark, 15.9.1996, D.K. Upreti & J. Tandon L104639 (LWG). **West Bengal**, **Darjeeling district**, Sandakhpoo-Phalut, alt. 11000-12000 ft, on bark, 6.6.1960, M.N. Bose 60.138 (LWG), Batasi-Palmajua, alt. 8000 ft, on bark, June 1948, D.D. Awasthi 396 (LWG-AWAS). **Manipur**, on bark, Watt 6949 (LWG).

Remarks—In having pseudocyphellae on both sides, *Nephromopsis rhytidocarpa* closely resembles *N. asahinae* (M. Satô) Räsänen, which differs in having yellowish green (not brownish) pigmentation, a thinner and less coriaceous thallus with wider lobes, lacks a P+ orange-red medulla, and has protocetraric, fumarprotocetraric, and physodalic acids in the thallus.

Ecology & distribution—*Nephromopsis rhytidocarpa* is corticolous and is distributed at 2210–4000 m in Andaman Islands, Manipur, Sikkim, Uttarakhand, and West Bengal's Darjeeling district.

Nephromopsis rugosa Asahina, *J. Jap. Bot.*11(no. 1): 12 (1935) Fig. 6c,d

≡ *Cetraria rugosa* (Asahina) M. Satô, in Nakai & Honda, Nova Flora Japonica 1: 46 (1939)

Thallus foliose, corticolous, loosely attached, 7–20 cm in diameter; lobes rounded ≤3 cm wide; upper surface yellowish or greenish tinge, regularly reticulate; soredia and isidia absent; lower surface light whitish, yellowish to brown, reticulate, rhizines simple, sparse; pseudocyphellae on lower surface in the form of minute flat white spots; medulla white. Apothecia marginal on the lower side of thallus, rounded or reniform, 5–15 mm in diam., disc brown; asci clavate, 35–40 × 7–10 µm; ascospores hyaline, oblong, 7–9 × 3–5 µm. Pycnidia frequent, marginal to laminal, on black emergent projection; pycnoconidia bifusiform, 2–5 × 1–1.5 µm.

Chemistry—Medulla K–, C+ pink, KC+ red, P–; usnic acid in cortex and olivetoric acid are present in TLC.

Specimen examined—**INDIA, Arunachal Pradesh, Tawang District**, Madhwei Lake, Tawang, alt. 3708 m, on bark of *Abies* tree, 14. November 2013, R. Debnath 19-037819 (LWG).

Remarks—*Nephromopsis rugosa* shares a C+, KC+ thallus with *N. stracheyi*, which differs in lacking reticulate thallus and olivetoric acids. *Nephromopsis laii,* which also has oblong ascospores, differs in a slightly rugose thallus and the presence of lichesterinic and protolichesterinic acids.

Ecology & distribution—*Nephromopsis rugosa* is corticolous and occurs at 3708 m in Arunachal Pradesh. Previously this species was known from Russia, Japan, Mongolia (Schubert & Klement 1977). This is the first record for India.

Nephromopsis sikkimensis (Divakar & Upreti) Randlane & Saag, Cryptog. Mycol. 34: 90 (2013)

≡ *Tuckneraria sikkimensis* Divakar & Upreti, Bot. J. Linnean Soc. 150: 249 (2006)

Thallus foliose, corticolous, loosely attached, ≤13 mm wide; lobes 4–8 mm wide, margin ciliate; cilia black to brown, ≤2 mm long; upper surface pale yellow to yellow, smooth, shiny; soredia and isidia absent; lower surface black, pale brown at margins, smooth to slightly rugose; pseudocyphellae present, punctiform near periphery and elliptic towards centre, brown to black rimmed; rhizines present in central part of thallus; medulla white. Apothecia unknown. Pycnidia marginal, emergent and verruciform; pycnoconidia citriform, 3 × 1 μm.

Chemistry—Medulla K–, C–, KC–, P–; usnic acid in cortex; lichesterinic acid present in TLC.

Specimens examined—**INDIA, Sikkim, North Sikkim**, 2 km before Shinghbo Rhododendron Sanctuary, near Yumthang, alt. 3500 m, on bark, 15.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004112, 04-004195 (LWG). **Uttarakhand, Bageshwar district**, Phurkia to Pindari Glacier, near Mirtoli, alt. 3400 m, on bark, 11.6.1970, D.D. Awasthi 7695 (LWG-AWAS).

Remarks—*Nephromopsis sikkimensis* shares the presence of cilia and usnic and lichesterinic acids with *N. ahtii,* which can be separated by its grey to greenish upper surface and bifusiform pycnoconidia measuring 5 × 1.5 μm.

Ecology & distribution—*Nephromopsis sikkimensis* is corticolous, growing on *Rhododendron* bushes in moist and open places at 3400–3500 m. Its distribution is restricted to the states of Sikkim and Uttarakhand.

Nephromopsis stracheyi (C. Bab.) Müll. Arg. Flora 74: 374 (1891)

≡ *Cetraria stracheyi* C. Bab., Hooker's J. Bot. Kew Gard. Misc. 4: 245 (1852)

≡ *Platysma stracheyi* (C. Bab.) Nyl., Syn. Meth. Lich. 1: 305 (1860)

Thallus foliose, corticolous, loosely attached, 15–20 cm across; lobes convoluted, ≤3–4 cm wide, lacking black fibrils along margins; upper surface

greenish grey to yellowish green, smooth to rugose; isidia and soredia lacking; lower surface pale brown, reticulately nervose-rugose; pseudocyphellae sessile or depressed on plain surface or on ridges; rhizines short, sparse, ≤1 mm long; medulla white. Apothecia marginal on lower side, nephromoid, oblong or reniform, 15 × 10 mm in size; ascospores simple, hyaline, 5–9 × 3 µm. Pycnidia not seen.

Chemistry—Medulla K–, C+ red, KC+ red, P–; usnic acid in cortex; anziaic, lichesterinic, and protolichesterinic acids present in the medulla in TLC.

Specimens examined—**INDIA, Arunachal Pradesh, West Kameng district**, Bomdila to Rahung, alt. 8200ft., on bark, 15.5.1958, R.S. Rao 7358 (LWG). **Sikkim, West Sikkim district**, Dzongri, alt. 4000 m, on bark, 23.5.1960, M.N. Bose B (LWG-AWAS). **Uttarakhand, Bageshwar district**, Dhakuri ridge, alt. 3000 m, on bark, 8.6.1970, D.D. Awasthi 7591 (LWG-AWAS), 22.5.1972, A. Singh 89312/A (LWG), from Dhakuri to Khati, alt. 2638 m, on bark, 11.5.2007, S. Joshi & Y. Joshi 01-010069 (LWG), Dwali to Kafni, alt. 3500 m, on bark, 25.5.1972, A. Singh 89351 (LWG), Dhakuri ridge, alt. 3000 m, on bark, 8.6.1970, D.D. Awasthi 7591 (LWG-AWAS), 19.5.1950, D.D. Awasthi & A.M. Awasthi 642/B (LWG-AWAS), Dhakuri Pass, alt. 3000 m, on bark, 4.6.1982, P.C. Pande 82-54363 (LWG), enroute to Pindari Glacier, Dwali to Kafni, alt. 2800 m, on bark, 24.5.1997, D.K. Upreti, S. Chattejee & J. Tandon L69071 (LWG), Sunderdhunga Glacier, between Jatoli and Dhuniyadon, alt. 3700 m, bark, 14.9.1995 (LWG); **Pithoragarh district,** Kalamuni, alt. 2670 m, on bark, 18.6.1973, A. Singh 102678 (LWG), Dharchula Sobhla, near village Vatan, alt. 2700 m, on bark, 26.9.1990, D.K. Upreti & G. Hariharan 202018 (LWG), Munsiyari, alt. 2250 m, on bark, 18.6.1973, A. Singh 102684 (LWG), Sirdung, Narain Swami Ashram, alt. 2400 m, on bark, 29.10.1983, D.K. Upreti L18425, L18410 (LWG), 2.11.2009, D.K. Upreti & G.K. Mishra 09-012196 (LWG), 29.10.1983, D.K. Upreti L18425 (LWG), Dharchula Shobla, near village Vatam, alt. 2700 m, on bark, 26.9.1990, D.K. Upreti & G. Hariharan 202018 (LWG), Kalamuni, alt. 2670 m, on bark, 18.6.1973, A. Singh 102678 (LWG); **Uttarkashi district**, Tehri Garhwal to Jamunotri, alt. 11500 ft, on bark, 22.6.1951, D.D. Awasthi 910 (LWG-AWAS). **West Bengal, Darjeeling district**, Tiger Hill, alt. 2800 m, on bark, 17.4.1960, M. N. Bose 6232, 6233 (LWG-AWAS), 5.3.1967, D.D. Awasthi & M.R. Agrawal, 67.49, 67.49 (LWG-AWAS), 6.10.1957, D.D. Awasthi 3877 (LWG), on way from Sandakhpoo to Phalut, alt. 4000 m, on bark, 16.6.1967, D.D. Awasthi & M.R. Agrawal 67.442, 67.509 (LWG-AWAS), near Pahnjua, alt. 3500 m, on bark, June 1948, D.D. Awasthi 176 (LWG-AWAS), Batasi to Paluajua, alt. 3600 m, on bark, June 1948, D.D. Awasthi 177 (LWG-AWAS), above Lachung Shingringtang area, alt. 2900 m, on bark, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004265 (LWG), Tiger hill, alt..7500 ft, on bark, 17.4.1960, M.N. Bose 6232, 6233 (LWG-AWAS), 6.6.1960, M.N. Bose 60.139 (LWG-AWAS), Tiger hill, north face, alt. 8500 ft, on bark, 5.5.1967, D.D. Awasthi & M.R. Agrawal 67.49 (LWG-AWAS).

Remarks—*Nephromopsis stracheyi* is similar to *N. rugosa*, which differs in having olivetoric acid in the medulla and smaller pseudocyphellae.

Ecology & distribution—*Nephromopsis stracheyi* is found growing on trees in open places at 2500–4500 m; it is widely distributed in Arunachal Pradesh, Sikkim, Uttarakhand, and West Bengal's Darjeeling district.

Nephromopsis togashii (Asahina) A. Thell & Kärnefelt,
Mycological Progress 4(4): 311 (2005)
≡ *Cetraria togashii* Asahina, J. Jap. Bot. 28: 136 (1953)
≡ *Tuckneraria togashii* (Asahina) Randlane & A. Thell, J. Hattori Bot. Lab. 78: 238 (1995)

Thallus fruticose, corticolous, ≤10 cm across; lobes 2–5 mm wide; upper surface yellow, fibrils absent at margin; lower surface pale brown to yellowish white; isidia coralloid branched, mainly marginal but occasionally laminal, soredia absent; pseudocyphellae plane and white, on lower surface; rhizines 1–2 mm long, dark brown to blackish; medulla white. Apothecia absent. Pycnidia frequent, spherical or subspherical, black coloured; pycnoconidia bifusiform (dumb-bell shaped), 3.7–4.5 × 1–1.5 µm in size.

Chemistry—Medulla K–, C–, KC+ yellow, P–; usnic acid in cortex; protolichesterinic acid present in TLC.

Specimens examined—**INDIA, Sikkim, North Sikkim**, 4 km from Lachung, alt. 3100 m, on *Cedrus deodara* tree trunk, 15.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004145, 04-004053 (LWG).

Remarks—*Nephromopsis togashii* shares an isidiate appearance with *Usnocetraria kurokawae* (Shibuichi & Yoshida) Lai & Wei, which can be distinguished in having different secondary metabolites containing fumarprotocetraric acid.

Ecology & distribution—This species is corticolous, growing on *Cedrus deodara* at 3100 m in Sikkim.

Nephromopsis weii X.Q. Gao & L.H. Chen, Mycotaxon 77: 492 (2001) Fig. 7
≡ *Tuckermannopsis weii* (X.Q. Gao & L.H. Chen) Randlane & Saag, Mycotaxon 87: 479 (2003)
≡ *Usnocetraria weii* (X.Q. Gao & L.H. Chen) M.J. Lai & J.C. Wei, J. Natnl Taiwan Mus.60 (1): 57 (2007)

Thallus foliose, corticolous, loosely attached, ≤5 cm in diam.; lobes ≤2–5 mm wide; upper surface olive brown to brown, smooth, shiny; soredia and isidia absent; lower surface pale brown to dark brown and slightly rugose, rhizines simple, sparse, laminal or marginal; pseudocyphellae on both surfaces; medulla white. Apothecia not seen. Pycnidia on tip of projections, black; pycnoconidia bifusiform, 3.5–4.5 × 1–1.5 µm.

Chemistry—Medulla K–, C–, KC–, P–; lichesterinic, protolichesterinic, and caperatic acids are present in TLC.

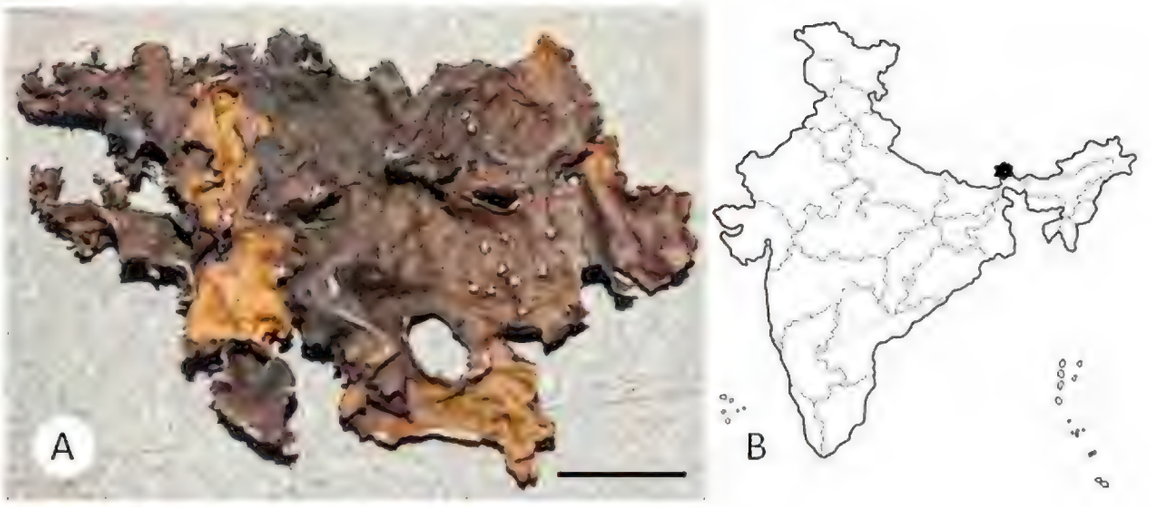

Fig. 7. ***Nephromopsis weii*** (LWG 04-004133).
A. habit; B. Indian distribution. Scale bar = 1 cm.

Specimen examined—**INDIA, Sikkim, North Sikkim**, Shingba Rhododendron Sanctuary, near Yumthang, alt. 3500 m, on bark, 15 August 2004, D.K. Upreti, S. Chetterjee & P.K. Divakar 04-004133 (LWG).

Remarks—*Nephromopsis weii* shares having pseudocyphellae on both sides of the thallus with *N. rhytidocarpa,* which can be distinguished by having a P+ red medulla (instead of P– thallus); *N. weii* is also morphologically similar to *N. thailandica* (Elix & M.J. Lai) Divakar & al., which differs in its K+ yellow-brown and P+ orange-red medulla.

Ecology & distribution—*Nephromopsis weii* grows on bark at ca. 3500 m in Sikkim Himalaya. This species was described from China (Chen & Gao 2001), and this is the first lichen record for India.

Nephromopsis yunnanensis (Nyl.) Randlane & Saag,
Mycotaxon 44(2): 488 (1992) Fig. 6e,f
≡ *Platysma yunnanensis* Nyl., Lich. Nov. Zeland. (Paris): 150 (1888)

Thallus foliose, corticolous, loosely attached, ≤20 cm in diameter; lobes rounded ≤5–15 mm wide; upper surface yellow to brownish; soredia and isidia absent; lower surfaces whitish to pale brown and extremely rugose, rhizines simple, sparse, laminal or marginal; pseudocyphellae on lower surface on ridges and plug-like outgrowth; medulla white. Apothecia not seen. Pycnidia frequent, marginal to laminal, on black, emergent projection; pycnoconidia bifusiform, 3–5 × 1–1.5 µm.

Chemistry—Medulla K–, C–, KC–, P–; usnic acid, lichesterinic, and protolichesterinic acids are present in TLC.

Specimen examined—**INDIA, Arunachal Pradesh, Tawang district**, Nagula, near Nagula lake, alt. 4137 m, on bark, 15 June 2015, R. Bajpai 15-026566 (LWG).

Remarks—*Nephromopsis yunnanensis* is morphologically and chemically similar to *N. ahtii,* which differs in possessing marginal cilia and emergent pycnidia; *N. yunnanensis* is also similar to *N. laii* in having pseudocyphellae on ridges; however, *N. laii* differs in having abundant apothecia.

Ecology & distribution—*Nephromopsis yunnanensis* grows on bark, at 4137 m in the Eastern Himalayan state of Sikkim. Earlier this species was reported from China and Xizang (Randlane & Saag 1998, 2001). This is a new lichen record for India.

Platismatia W.L. Culb. & C.F. Culb., Contr. U.S. Nat. Herb. 34: 524 (1968)

Thallus foliose, dorsiventral, heteromerous, rosette forming or wide spreading, lobate; lobes 3-25 mm wide, margin often ascending, wavy, sometimes crisped; upper and lower surface with a well-developed paraplectenchymatous cortex; upper surface grey to olivaceous green, with punctiform pseudocyphellae; isidia and sometimes soredia present; lower surface pale or black with few, scattered rhizines; photobiont green alga; medulla white. Apothecia marginal to submarginal; disc brown, often perforate; asci 8-spored; ascospores colourless, simple, ellipsoid or subglobose, 3.5–10 × 3–5 µm. Pycnidia marginal, immersed, or absent; pycnoconidia cylindrical, not swollen at apices.

Out of 11 species of *Platismatia* known worldwide (Randlane & al. 2013), a single species is reported from India.

Platismatia erosa W.L. Culb. & C.F. Culb.,
Contr. U. S. Natl. Herb. 34: 526 (1968)

Thallus foliose, terricolous, loosely attached, medium ≤12 cm across; lobes 5–20 mm wide, broadly rounded; upper surface light tan or ashy-grey, tinged with brown at the margins of the lobes, broadly reticulately ridged and veined; pseudocyphellate, pseudocyphellae with minute pores and often bearing isidial scars resembling pseudocyphellae; isidia usually infrequent, short, simple and usually confined to the ridges or thallus cracks but becoming coralloid and well developed at the margin of lobes; soredia absent; lower surface punctiform, jet black, the marginal zone light brown or tan; rhizines few, black, simple or fasciculate, confined to older parts; medulla white. Apothecia marginal to submarginal ≤7 mm broad; asci 8- spored, IKI+ dark blue; ascospores ellipsoid, 3–4 ×5–8 µm. Pycnidia not seen.

Chemistry—Thallus K+ yellow, C–, P–, KC–; atranorin and caperatic acids present in TLC.

Specimens examined—**INDIA, Sikkim, East Sikkim district**, near Karponang, alt. 2500 m, on soil, May 1947, D.D. Awasthi 354 (LWG), alt. 8500ft., on soil, May 1947, D.D. Awasthi 354 (LWG-AWAS), near Yumthang, alt. 3800 m, on soil, 15.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004161 (LWG); **North Sikkim district**, Near Yumthang, alt. 3800 m, on soil, 15.8.2004, D.K. Upreti, S. Chatterjee & P.K. Divakar 04-004161 (LWG), near Karponang, Kupup, north border side, alt. 4100–4200 m, on soil, G.P. Sinha 1511 (BSHC), Memencho lake surroundings, alt. 3200–3500 m, on soil, G.P. Sinha 1472 (BSHC), Shingba Rhododendron Sanctuary, alt. 3350 m, on soil, G.P. Sinha 1068 (BSHC), The Lajakthang way, alt. 4600–3400 m, on soil, G.P. Sinha 1711 (BSHC), Near Bakhim, alt. 3900–3500 m, on soil, G.P. Sinha 716 (BSHC), on way to between Dzongri-Thangsing foot track, alt. 3900–3500 m, on soil, G.P. Sinha 816 (BSHC).

Remarks—*Platismatia erosa* closely resembles *P. interrupta* W.L. Culb. & C.F. Culb., in having pseudocyphellae on the upper surface and isidia along the margins or on ridges of lobes, but *P. interrupta* differs in having large and conspicuous pseudocyphellae and a non-punctate lower surface.

Ecology & distribution—*Platismatia erosa* is terricolous, occurring at 2500–4600 m and only in the state of Sikkim in eastern Himalaya.

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